

FIRST POSTWAR EDITION

THE RADIO AMATEUR'S

# LICENSE MANUAL

- HOW TO GET YOUR AMATEUR RADIO LICENSES
- A STUDY GUIDE FOR THE AMATEUR EXAMINATIONS
- F. C. C. REGULATIONS CONVENIENTLY INDEXED
- RENEWING AND MODIFYING STATION LICENSES

25 CENTS



PUBLISHED BY AMERICAN RADIO RELAY LEAGUE

# CHANGES AND ADDITIONS

## New Bands

The discussion of temporary changes on page 9 of this booklet should now be regarded as replaced by the following discussion:

With amateur radio now rapidly being reopened and restored, the situation is changing frequently and the student should keep himself posted on the current status by inquiry of his local radio club or ARRL, or by listening to the broadcasts of the ARRL headquarters station, WIAW, nightly from Monday through Friday at 8, 9 and 10 p.m., EST, on 3,555, 7,145, 14,280 and 28,245 kc. As of 1 February 1946 the following is the situation:

Temporary FCC Orders 72 and 73 and their amendments, as appearing on pages 28-29, have been canceled; and likewise the close-down orders, 87, 87-A and 87-B. FCC Order 130-B now replaces the temporary authorization of last August and provides that station licenses that were valid at any time between Dec. 7, 1941, and Sept. 15, 1942, are validated for another six months — until 3 a.m., EST, May 15, 1946. Undoubtedly there will be a further extension. All such stations are authorized to operate on the following bands of frequencies:

28.0 - 29.7 Mc. — C.w. telegraphy

28.1 - 29.5 Mc. — A.m. 'phone

28.95 - 29.7 Mc. — F.m. 'phone

56.0 - 60 Mc. — C.w., i.c.w., a.m. 'phone, facsimile

58.5 - 60 Mc. — F.m. 'phone

except that the 56-60 band is available only until 3 a.m., EST, March 1, 1946. At that time, subject to further FCC order, television is to vacate our new band 50-54 Mc. and it will be assigned to us in lieu of 56-60.

144 - 148 Mc. — C.w., i.c.w., a.m. 'phone, facsimile, f.m. 'phone and f.m. telegraphy

except that 146.5 to 148 Mc. may not be used within 50 miles of Washington, D.C., Seattle and Honolulu. For amateurs in these areas the band, for the next several months, will be only 144-146.5 Mc.

420 - 430 Mc.	} C.w., i.c.w., a.m. 'phone, facsimile, television, f.m. 'phone and f.m. telegraphy
1,215 - 1,295 Mc.	
2,300 - 2,450 Mc.	
5,250 - 5,650 Mc.	
10,000 - 10,500 Mc.	
21,000 - 22,000 Mc.	

Power in the band 420-430 Mc. is temporarily limited to 50 watts peak antenna power.

## New Licenses

FCC is now issuing new station licenses as well as operator licenses. You may take the operator examination at any of the points listed on the inside front cover and may simultaneously

apply for a station license. If you already have an operator-only license, you may write your district inspector for an amateur application form and make application direct to FCC at Washington for a station license.

As to renewal or modification of existing licenses, see discussion hereunder of operator extensions. Station licenses are temporarily reinstated. Gradually during the year FCC will call for renewal applications from existing licensees, on a step-by-step geographical basis. Current information may be had from QST, ARRL Hq., or WIAW broadcasts.

## Canada

In Canada, amateur experimental station licenses in force immediately prior to the war were reinstated November 15th to be valid until March 31, 1946, but holders must obtain permission from the nearest Government Radio Inspector before going on the air. New licenses are being issued upon application. The frequency-band limits are the same as above, but all the frequencies may be used for a.m. 'phone, although f.m. 'phone may operate only above 58.5 Mc.

## No More Registrations

Orders 101 (page 29) and 99, requiring the registration of transmitters as well as their licensing, have now been canceled. All mention of this subject in this booklet may now be ignored.

## Five-Year Terms

Wherever, in this booklet, reference is made to the term of amateur licenses being three years, it should now be read as five years. On October 3, 1945, FCC decided that postwar licenses shall be for a term of five years, by amending Sec. 12.64 and adopting a new Sec. 12.28 so that they now read as follows:

12.28 License term. Amateur operator licenses are normally issued for a term of five years from the date of issuance.

12.64. License term. Amateur station licenses are normally issued for a term of five years from the date of issuance of a new, renewed, or modified license.

## Operator Extensions

Referring to paragraph (3) on page 9, about the automatic extension of amateur operator licenses by FCC Orders 115 and 115-A (page 30): There has been a further extension of an additional group of licenses, by FCC Order 115-B, which orders that:

Every amateur radio operator license which, either by its own terms or as extended by Orders Nos. 115 and 115-A, would expire during the period December 7, 1945, and December 7, 1946, is hereby extended for a period of one year from the date on which it would otherwise expire. Provided, however, . . . (Rest of order same as Order 115.)

Thus no amateur operator license valid at Pearl Harbor or since has been permitted to expire, and no renewal applications are necessary until FCC calls for same.

### **Waiver of Proof of Use**

Licenses are normally renewable only upon showing that they have been used. During the war this requirement was waived. See Order 77-D, page 29. There is now a new FCC Order 77-E, effective 1 January 1946, which further suspends this requirement "until further order of the Commission, but in no event beyond June 30, 1946."

*No. 3-19, February 1, 1946.*

### **Citizenship-Proof Eliminated**

FCC Order 75 (page 29) has been replaced by Order 75-D, altering the discussion on page 5 of this booklet. Documentary proof of citizenship is no longer required in average cases, although FCC retains the right to require further information on the qualifications of any applicant. Fingerprints, on Form 735-A, are still required with each application for new operator license or renewal, unless such a showing has previously been submitted by the applicant.

# F.C.C. AMATEUR EXAMINATIONS FOR 1946

**THE** Federal Communications Commission will give amateur examinations during 1946 on the following schedule. Remember this list when you need to know when and where examinations will occur. Where exact dates or places are not shown below, information may be obtained, as the date approaches, from the Inspector-in-Charge of the district. An asterisk (\*) indicates that the examination dates shown are subject to change and should be verified from the inspector as the date approaches. No examinations are given on national or state holidays. All examinations begin promptly at 9 A.M., local time, except as noted below:

Albuquerque: Mar. 19, Sept. 12.  
 Allegan, Mich. (P. O. Box 89): By appointment.  
 Amarillo, Tex.: Mar. 14, Sept. 10.  
 Atlanta, 411 Federal Annex: Tuesday and Friday at 8:30 A.M.  
 Bakersfield, Calif.: Some time in February and August.  
 Baltimore, 508 Old Town Bank Bldg.: Wednesday, Friday and by appointment.  
 Bangor, Me.: Apr. 18\*, Oct. 17\*.  
 Beaumont, Tex., 329 P. O. Bldg.: Thursday and by appointment.  
 Birmingham: Jan. 19, Apr. 20, July 20, Oct. 19.  
 Billings, Mont.: Apr. 29\*, Oct. 1\*.  
 Bismarck, N. D.: Some time in April and October.  
 Boise: Some time in April and October.  
 Boston, 7th floor Customhouse: Monday through Friday.  
 Buffalo, 328 Federal Bldg.: First and third Thursdays of each month.  
 Butte, Mont.: Apr. 24\*, Oct. 4\*.  
 Charleston, W. Va.: Some time in March, June, September and December.  
 Chicago, 246 U. S. Courthouse: Friday.  
 Cincinnati: Some time in February, May, August and November.  
 Cleveland, 541 Old P. O. Bldg.: First and third Fridays each month, also by appointment.  
 Columbus, Ohio: Some time in January, April, July and October.  
 Corpus Christi: Mar. 14, June 13, Sept. 12, Dec. 11.  
 Cumberland, Md.: Apr. 17, Oct. 17.  
 Dallas, 500 U. S. Terminal Annex: Monday through Friday.  
 Davenport, Ia.: Some time in January, April, July and October.  
 Denver, 504 Customhouse: First and second Thursdays of each month.  
 Des Moines: Jan. 10, Apr. 5, July 11, Oct. 11.  
 Detroit, 1029 New Federal Bldg.: Friday and by appointment.  
 El Paso: Mar. 23, Sept. 14.  
 Fort Wayne: Some time in February, May, August and November.  
 Fresno: Mar. 20\*, June 19\*, Sept. 18\*, Dec. 18\*.  
 Galveston, 404 P. O. Bldg.: Tuesday and Friday.  
 Grand Island, Nebr. (P. O. Box 788): Monday through Friday but only by appointment.  
 Grand Rapids: Some time in January, April, July and October.  
 Hartford, Conn.: Mar. 19\*, Sept. 17\*.  
 Hilo, T. H.: Apr. 8, Oct. 21.

Honolulu, 609 Stangenwald Bldg.: Monday at 8:30 A.M.  
 Indianapolis: Some time in February, May, August and November.  
 Jacksonville: May 4, Nov. 2.  
 Juneau, Alaska, 7 Shattuck Bldg.: Monday through Friday and by appointment.  
 Kansas City, 809 U. S. Courthouse: Friday and by appointment.  
 Kauunakakai, T. H.: Oct. 14.  
 Kingsville, Tex. (P. O. Box 632): Monday through Friday but only by appointment.  
 Klamath Falls, Ore.: Some time in May and November.  
 Lanai City, T. H.: Oct. 9.  
 Las Vegas, Nev.: Some time in April and October.  
 Lihue, T. H.: Apr. 29, Oct. 30.  
 Little Rock: Jan. 16, Apr. 10, July 17, Oct. 9.  
 Los Angeles, 539 U. S. P. O. & Courthouse Bldg.: Wednesday at 9:00 A.M. and 1:00 P.M.  
 Memphis: Feb. 20, May 22, Aug. 21, Nov. 20.  
 Miami, 312 Federal Bldg.: Monday and Friday.  
 Milwaukee: Some time in January, April, July and October.  
 Mobile: May 15, Nov. 6.  
 Nashville: Feb. 15, May 17, Aug. 16, Nov. 15.  
 New Orleans, 400 Audubon Bldg.: Monday at 8:30 A.M. and by appointment.  
 New York, 748 Federal Bldg., 641 Washington St.: Monday through Friday.  
 Norfolk, 402 New P. O. Bldg.: Friday.  
 Oklahoma City: Jan. 22-23, Apr. 23-24, July 23-24, Oct. 22-23.  
 Omaha: Jan. 17, Apr. 12, July 18, Oct. 18.  
 Philadelphia, 1200 Customhouse: Requiring code test, 9-9:30 A.M. and 1-1:30 P.M. Wednesday. Not requiring code test, 9 A.M. to 1:30 P.M. Monday through Friday.  
 Phoenix, Ariz.: Some time in April and October.  
 Pittsburgh: Feb. 13\*, May 10\*, Aug. 8\*, Nov. 7\*.  
 Portland, Me.: Apr. 16\*, Oct. 15\*.  
 Portland, Ore., 805 Terminal Sales Bldg.: Friday at 8:30 A.M.  
 Reno: Apr. 17\*, Oct. 16\*.  
 Roanoke: Apr. 6, Oct. 5.  
 St. Louis: Feb. 7, May 17, Aug. 8, Nov. 15.  
 St. Paul, 208 Uptown P. O. & Federal Courts Bldg.: First and third Fridays of each month.  
 Salisbury, Md.: Mar. 7, Sept. 12.  
 Salt Lake City: Mar. 23\*, June 22\*, Sept. 21\*, Dec. 21\*.  
 San Antonio: Feb. 27-28, May 23-24, Aug. 21-22, Nov. 13-14.  
 San Diego, 307 U. S. Courthouse: By appointment.  
 San Francisco: 328 Customhouse: Monday.  
 San Juan, P. R., 322 Federal Bldg.: By appointment.  
 Savannah, 214 P. O. Bldg.: By appointment.  
 Schenectady: Mar. 13-14, June 12-13, Sept. 11-12, Dec. 11-12.  
 Seattle, 808 Federal Office Bldg.: Friday.  
 Sioux Falls, S. D.: Some time in March, June, September and December.  
 Spokane: Apr. 18\*, Oct. 10\*.  
 Syracuse, N. Y.: Jan. 9\*, Apr. 9\*, July 9\*, Oct. 8\*.  
 Tampa, 409 P. O. Bldg.: By appointment.  
 Tucson, Ariz.: Some time in April and October.  
 Tulsa: Jan. 25, Apr. 26, July 26, Oct. 25.  
 Wailuku, T. H.: Oct. 12.  
 Washington, D. C., 410 International Bldg., 1319 F St., N.W.: Monday through Friday.  
 Wichita: Mar. 8, Sept. 13.  
 Williamsport, Pa.: Mar. 12\*, June 4\*, Sept. 10\*, Dec. 3\*.  
 Wilmington, N. C.: Some time in June and December.  
 Winston-Salem: Feb. 2, May 4, Aug. 3, Nov. 2.



# THE RADIO AMATEUR'S LICENSE MANUAL

**T**o own and operate an amateur radio transmitting station in the United States it is necessary to have two licenses, both of which are issued by the Federal Communications Commission, at Washington, D. C. For the operator himself there is the *operator's license*, issued after the individual has passed a code test and a written examination designed to test his familiarity with radio law and regulations and his knowledge of the proper operation of amateur transmitting equipment; the holder of an operator license can operate any amateur station, his own or someone else's (subject to the regulations, of course). For the transmitting equipment itself there is the *station license*, which licenses the operation of one particular collection of transmitting equipment at a specified location and also authorizes portable and portable-mobile operation as permitted under the regulations.

*It is absolutely essential that both licenses be obtained before an amateur station of any kind is operated.* We wish to emphasize this point and, further, to emphasize that there are no exceptions to the requirement for licenses. Those who, after study, think that the language of the law is such as to permit of some special interpretation which will enable unlicensed operation under certain conditions are warned that the language of the law is air-tight, and no such special interpretations are possible. Please do not write us, therefore, asking if unlicensed operation isn't all right if the power used is so low that the station won't be heard over the state line, or if licenses are required for 2½-meter transceivers, or anything of that sort; you will only be wasting your time and ours. To make it perfectly clear, we will repeat that under no circumstances can any sort of radio transmitting equipment for communication be operated without a station license for the equipment and an operator license for the operator. If we appear to be stressing this point unduly, it is only because, in spite of all we say, many individuals each year write us asking if licenses are necessary in this special case or that. There are no special cases; licenses are *always* necessary. The loss of future operating privileges as well as the prospect of fine and imprisonment face the unlicensed operator who is sure *he* is an exception.

There is no age limit for amateurs. However, only American citizens can own and operate amateur stations in the United States. Since aliens possessing first papers are not yet full-fledged citizens, they also are barred from holding licenses. Every applicant must prove his citizenship, as hereinafter explained.

## *The Combination Station-Operator License*

In its physical form, the amateur license is a white card 3 inches by 5 inches. This represents both the station and operator licenses, the station license appearing on one side and the operator license appearing on the reverse side.

Most people getting licenses intend to have stations of their own and therefore obtain both station and operator licenses. However, a person wishing to get only an operator license can do so; simply state you want the operator license only, and leave blank all portions of the application form with respect to the station-license application. It should be mentioned, though, that it is impossible for an individual to get a station license alone, without at the same time getting an operator license; it is required that a person who wants an amateur station license must also qualify as an amateur operator.

Moreover, only an *amateur* operator may operate amateur stations, and even the holder of a "commercial" must obtain an amateur operator license, in addition, if he wishes to operate an amateur station.

It is not necessary that you *post* your license in your radio room, but it is required that you have it in your personal possession whenever you are operating.

## *The Station License*

The station-license part of the combined license is the station's "registration." It licenses a collection of apparatus at a particular address (with certain restricted portable privileges, however) to be operated as an amateur station in the amateur frequency bands. It designates the official call to be used. It is secured by filling in those portions of the combined license-application form which deal particularly with the station-license application. (However, you will not be issued a

station license unless you can say, on the application, that you have the necessary equipment for a station.)

Station licenses will not be issued where the property on which the station or its control point is to be located is controlled by an alien. If you are an American citizen and own your own home you may have a station there. If you are a citizen, renting the house or apartment where you live, you may have a station even though the actual owner from whom you rent is an alien. Your rental of the property brings it under your control. On the other hand, if you are merely boarding with a family of aliens, or if your parents or your guardians are aliens and are the actual owners or renters of the property where you live, you cannot get a station license for that location even though you yourself are a citizen. The premises in both the latter cases are controlled by aliens.

The station license should always be at hand whenever the station is being operated. If your station is to be operated by someone in your absence, either leave your license at your station or have a facsimile of the station authorization made and post that in your shack.

**IMPORTANT:** A station may be operated only to the extent of privileges for which its *owner* is licensed as an operator: i.e., a station owned by a *Class-B* or *Class-C* licensee may not be operated in the *Class-A* bands even though a *Class-A* operator is present and in charge of the equipment.

The station license runs concurrently with the operator license and like the latter has a term of three years. It may be renewed, as will be outlined later.

#### Portable Operation

The possession of a station license automatically authorizes you to operate a portable station, but at the present time the usual portable privileges have been restricted (see F.C.C. Orders 73 and 73-A at the rear of this booklet) to the amateur frequencies above 56,000 kc., except that in actual emergencies or for week-end (Saturday-Sunday) testing of self-powered emergency apparatus in daylight hours pursuant to 48-hours notice, portable apparatus may still be employed on lower frequencies under the terms of Secs. 12.82, 12.83, 12.92 and 12.136 of the amateur regulations—see the details under Order 73-A. Portable-mobile operation (from aircraft, automobiles, boats, etc.) was always restricted to amateur frequencies above 28,000 kc. as outlined in Sec. 12.91, but at the present time is further restricted to frequencies above 56,000 kc. by Order 73, except as permitted on week-ends on the 28-30 Mc. band by Order 73-A. Logs must be kept in all cases, of course.

When operating either portable or portable-mobile under these regulations and special orders, be sure to have your combination license with

you while operating equipment under your own call. If not operating your own portable equipment, be sure that you have with you either the original combination license for the call under which the portable equipment is being operated, or a photocopy of the station authorization for that call. This, of course, is in addition to your own operator license, which you must also have with you. If you have a portable station operating under your call but not being operated by yourself, see to it that whoever is doing the operating has either your combination license or a photocopy of the station authorization with him. You should also be sure such operator is licensed and has his own amateur operator license with him, since you are legally responsible for the proper operation of equipment being operated under your call.

Do not operate an unlicensed fixed station under your own call as a "portable," as this constitutes illegal operation. Nor should you operate a licensed fixed station other than your own under your call on a portable basis; your call and your station license apply only to your own station and cannot be used in connection with the fixed station of someone else. In such circumstances, use his call, and see to it that you not only have your own operator license with you but that a photocopy of his station license, or the license itself, is in the operating room.

#### Temporary Operation

Portable procedure is ordinarily confined to truly portable apparatus but there are two conditions under which your own fixed station may be operated temporarily in portable status. These are:

(1) While awaiting receipt of modified license after you have moved your station to a new permanent location and asked for modification. See Sec. 12.93 (a). Such operation cannot be continued more than four months nor beyond the license's expiration. You must send *monthly* notification of the circumstances to the radio inspector concerned, as required by Sec. 12.92, and must sign the portable indicator. See also the discussion under "Modifications."

(2) When, as during a vacation, for instance, you have set up your fixed station at some temporary address but with the intention of returning after a short time to the address specified on your license, or of shortly moving to still another fixed location. See Sec. 12.93 (b). Unless you are to be at a certain temporary location for at least 15 days you are not permitted to make such a move. If you intend to be there longer than four months, you should immediately apply for modification. But if the occupancy is to be for between 15 days and four months you may notify, move, employ the portable indicator, and move again or move back home. Under this rule, only one notification is necessary for any period up to four



months, but you must send this notice not only to the inspector in whose district you will be operating but to F.C.C. at Washington as well, and must send additional such notices when you resume operating back home or move to still another temporary address.

In either of the above cases it is well to state in your letter of notification that you do not refer to the operation of portable equipment but to a move of your fixed station under Sec. 12.93 (a) or 12.93 (b), as the case may be.

## Remote Control

While most amateur stations are controlled from the same address at which the transmitter is located, some amateurs desire to control their stations from a remote operating point. As this requires some special precautions, special F.C.C. authority is necessary, each case being considered on its merits. See Sec. 2.53 of the rules for the technical conditions necessary for obtaining authority to operate without an operator on duty at the transmitter location. Sec. 12.63 requires both antenna location and control point to be on premises not controlled by an alien, and lists the other showings that you must make for remote control. In an initial application for a new station using remote control, your answer to Question 26 of the application form will supply most of the required data, although you may find it desirable to explain some of your arrangements by an accompanying letter and to support your showing of legal control of the control point by auxiliary documents. If you are already licensed without remote control, and desire to install same, you must apply for modification of your station license to authorize the changes and to put the data on record through your responses to Question 26.

## The Operator License

The operator authorization on the combined license testifies to the holder's ability to operate an amateur station — not only his own station but any amateur station. A person who wishes only an operator license may apply for just it, even if he personally does not own a station, by filling out only those portions of the application form dealing with the operator ticket.

Always have your operator license in your personal possession whenever you are operating. Be sure to take it along with you whenever you happen to be operating some station other than your own; the station license part of it is no good to you under these circumstances, of course, but you need it for the operator authorization.

Like the station license, with which it is combined and concurrent, the operator license runs for a period of three years.

To determine that the applicant has the requisite ability the government requires that he pass a written examination (in addition to filling out

the application form) to show that he is familiar with simple radio theory, operation and adjustment of basic transmitting equipment, both telegraph and 'phone, and with the essential parts of the radio law and regulations. The written examination is described in detail in the section entitled "Passing the Operator Examination" beginning on page 8; the questions and answers in this booklet indicate its nature and scope. It is also required that the applicant demonstrate ability to send and receive Continental Morse code at the rate of thirteen words per minute (five letters to the word, each numeral or punctuation mark counting as two characters). That the applicant intends to use 'phone rather than telegraphy does not excuse him from this code test; everybody has to take it.

Learning the code is mostly a matter of practice. Instructions on learning it, on how to handle a key, data on practice sets, etc., are contained both in *Learning the Radiotelegraph Code* (25¢) and in Chapter 14 of *The Radio Amateur's Handbook — Defense Edition* (\$1), obtainable postpaid from American Radio Relay League, West Hartford, Conn.

There are three classes of amateur operator privileges but two of these are substantially identical in effect, so that it is easier to consider that there are two grades. The *Class A* is sometimes referred to as the "unlimited 'phone" license since, in addition to carrying the privileges authorized under the *B* and *C* licenses, it enables the holder to operate 'phone in the two restricted bands 3,900-4,000 kc. and 14,150-14,250 kc.

The *Class B* and *Class C* licenses do not entitle the holder to operate 'phone in the two restricted bands just noted but do permit him to engage in all other amateur operation. These two classes (*B* and *C*) are identical so far as privileges are concerned, their only difference being that the *Class B* is issued only when the license examination has been taken in the presence of the radio inspector, while the *Class C* is issued on the basis of a mail examination. The *Class B* is compulsory for all persons living within 125 miles airline of an office of the Commission or a point where examinations are held quarterly or by appointment (exceptions: Alaskans; Virgin Islanders; shut-ins, as noted below; and residents at CCC camps, military and naval personnel located at a military post or naval station, per Sec. 12.21).

Persons living more than 125 miles from an examining point may take the examination by mail and obtain a *Class C* license, which may be renewed indefinitely as long as the licensee remains in a *Class C* area. However, if a *Class C* licensee moves into a *Class B* area (within 125 miles of an examining point) he must, within four months, appear at the examining point and take the *Class B* examination and code test, or forfeit his *Class C* license. The same thing is true if the

FCC establishes a new quarterly examining point whose new 125-mile circle includes him. Furthermore, if a *Class C* licensee under any circumstances violates the regulations or otherwise incurs the official displeasure of the FCC, he may be called upon to journey to the nearest examining point, even though it be many hundreds of miles away, to be given the *B* examination, or lose his *Class C* ticket. In any of the above cases, failure of the applicant on the *Class B* examination bars him from ever again being issued a *Class C* license.

Let us now treat the *Class B* and *C* licensing procedure in somewhat more detail.

### Applying for Licenses

This section will be devoted to *Class B* and *Class C* applications; the *Class A* will be treated later in a separate section preceding the *Class A* examination questions.

We have just pointed out that anyone living within 125 miles of an office of the Commission or a point where examinations are held quarterly or by appointment must, under the regulations, travel to that point and take the examination under the supervision of the inspector or one of his staff. Let us see what those points are.

There are 50 such examining centers, 47 in continental U. S. and one each in Alaska, Hawaii and Puerto Rico. Of these, 23 are the district administrative offices of the FCC, and a list of them appears in a table at the rear of this booklet. Examinations are given at the district offices several times a month. Examinations are also quickly available, either on published schedule or by appointment, at the main office of FCC in Washington and at the suboffices at Savannah (branch of Atlanta), Tampa (branch of Miami), San Diego (branch of Los Angeles), Cleveland (branch of Detroit) and Beaumont, Tex. (branch of Galveston). In addition, examinations are held quarterly at the following cities: Birmingham; Charleston, W. Va.; Cincinnati; Columbus, Ohio; Davenport; Des Moines; Ft. Wayne; Fresno; Grand Rapids; Indianapolis; Little Rock; Milwaukee; Nashville; Oklahoma City; Pittsburgh; St. Louis; Salt Lake City; San Antonio; Schenectady; Sioux Falls, S. D.; Syracuse, N. Y.; and Winston-Salem. An inquiry to the office of the inspector in whose district is located the particular city in which you are interested will bring information on the exact place and date of the examination. See the inside front cover of this booklet for additional information.

Now, if you live within 125 miles *airline* of one of the above 50 examining points (except in Alaska or the Virgin Ids.) you should write or visit the inspector of the district in which you live, asking for an application blank for amateur station and operator license, and the date when examinations will be held in the city at which you wish to appear. Fill out the application form and mail it

back to the inspector's office, and then appear at the specified time for personal examination. First the inspector gives you your code test; if you are successful in passing this you will be given the written exam. After the examination is completed you can go home; the inspector sends all the papers to Washington and if you were satisfactory your combination license comes direct to your home a few weeks later. If, instead of receiving your licenses, you are notified that you failed, you have the privilege of taking the examination again (any number of times, if necessary) but must wait two months after the previous date of taking the test before taking it again.

Examinations for both *Class A* and *Class B* are also held *twice* a year in the following auxiliary list of cities: Albuquerque, N. M.; Bangor, Me.; Billings, Mont.; Bismark, N. D.; Boise, Idaho; Butte, Mont.; Corpus Christi, Tex.; Cumberland, Md.; Hartford, Conn.; Jacksonville; Memphis; Mobile; Omaha; Portland, Me.; Phoenix, Ariz.; Reno; Roanoke, Va.; Spokane; Wichita; Williamsport, Pa. Since the *Class B* examination is thus conveniently available to applicants in those vicinities, they are urged to appear for personal examination. But one is not obliged to qualify for *Class B* just because one lives within 125 miles of one of the auxiliary cities mentioned in this paragraph, since examinations come there only every six months. If the travel is inconvenient, one may apply for *Class C* if otherwise eligible.

If you live more than 125 miles *airline* from any of the 50 examining points mentioned earlier (or live in Alaska or the Virgin Ids.), write the inspector of the district in which you live, asking for a *Class C* amateur operator and station application blank, examination, etc. He will send you an application form called Form 610, a return envelope addressed to the Federal Communications Commission at Washington, and a sealed envelope containing a set of examination questions, and instructions thereon. *Before doing anything else, read the instructions carefully.*

Now, as part of the *Class C* examination you have to have yourself examined in code speed by some licensed operator with whom you have made an arrangement to that effect. He must either be the holder of a *Class A* or *Class B* amateur license or must hold or have held within five years a license as a professional radiotelegraph operator or must be or have been employed within five years as a radiotelegraph operator in the service of the United States. See Sec. 12.44. You will also have to provide yourself with a witness who will open the envelope of questions and certify that you wrote out the answers without assistance. This may be the same person who gives you your code test; if it is someone else, that person must be someone of legal age. If you do not know a licensed operator in your vicinity, communicate with the nearest radio club or write your ARRL Section Communications Man-



ager (directory in front of every issue of the League's magazine *QST*). You must know the name of your examiner-witness before filling out the application. There is, in fact, a specified sequence: first you fill out Form 610 (the application) which includes the data on the examiner and witness, and then you swear to it before a notary. Next you get your code examiner to give you your code test and to fill out and swear to a statement of your code speed, for which a space is provided on the application form. Then, and only then, are you ready for the written examination. If you do not pass the code test, you must return the examination envelope unopened, and wait two months before trying again. But if your code speed test was passed successfully, and the statement sworn to, your witness may then open the sealed examination envelope. He examines it and sees that it consists of a number of sheets of paper, bearing the examination questions. He hands these to you. You proceed to the answering of the questions. You must, unless disability prevents, write with ink, not typewriter or pencil, although you may draw any necessary diagrams with pencil. Your witness must remain constantly present, and at the conclusion sign and swear to a statement that he opened the envelope and that you wrote out the answers in his presence and without assistance from any source. There is space for this also on the application form. Then you put both the application form and the examination sheets in the envelope provided, and mail them direct to the Federal Communications Commission. If you have passed, your license will come to you in about three weeks. If you have failed (you will be notified but will not be told on what questions you failed) don't be too discouraged — study some more for the examination and after two months try it again.

(Note: If, after failing either the code test or the written examination, a *Class C* applicant is willing to take his chances on personal examination before an inspector for a *Class B* license, he does not have to wait two months from the time of his *C* failure but can go up for the *B* examination as soon as he wants — even the next day.)

The application Form 610 is self-explanatory and needs no treatment here except to say that you should not be concerned over that item which requires you to waive claim to the use of any particular frequency or of the ether as against the regulatory power of the United States. This is a form requirement under the law, and agreement is required of all licensees, whether amateur or commercial.

Applicants for amateur licenses in the U. S. Pacific islands and Alaska may apply for *Class C* licenses through the offices of the inspectors at San Francisco and Juneau, respectively; in this case they must make arrangements for their code tests with such persons as qualify under

Sec. 12.44. Or, if desired, applicants in Guam may take the *Class B* examination, in which case they must make arrangements with the Naval District Communications Officer at Agana, Guam, who will undertake to give the examination to the applicant. *Class B* is also available in Alaska by appointment with the Juneau inspector or by arrangement with any Army official, who will secure the sealed envelope for the examination from the inspector and administer the test. All postmasters in Alaska, by the way, are now authorized to administer the necessary oaths. Readers interested in *Class A* for these territories and possessions are referred to the introduction to the *Class A* examination which appears farther on in this booklet.

## Proof of Citizenship

FCC Order No. 75, printed in the rear of this booklet, requires every applicant for a new amateur license to prove his U. S. citizenship. When you get your application blanks from your inspector, you will also receive a special questionnaire, a fingerprint card, a copy of the order, and a complete set of instructions. The order must be complied with carefully. If you live within 125 miles airline of an examining point, and are to appear in person for examination for *Class B* or *A*, fill out the forms and have the required papers with you and ready when you appear for examination. Turn them over to the inspector, who will attach them to your examination paper for transmittal to Washington. If you are a *Class C* applicant and have received your examination papers by mail, complete the forms and attach them to your examination papers when you mail them in to Washington.

The form is easy to fill out. It simply requires data on your birth, on what your citizenship is based, your military record, your absences from the country, the citizenship of your close relatives, etc. It must be sworn to. A passport type photograph must be affixed: full-face, bare-headed, taken within the past year, not over 2½ by 2½ inches.

You must attach to this form a documentary proof of citizenship. The instruction sheet will give full details. If available, you must supply a certified copy of either public birth record or baptismal or other church record. If neither is available, you may then rely upon a family record, hospital birth record, attending physician's statement, or report of the Census Bureau. If none of these is available, you may prove your case by the submission of two or more auxiliary documents, such as school records, passports, military discharge papers, insurance policies, affidavits of parents.

Your fingerprints must be impressed upon the fingerprint form in the presence of an official of a municipal, state or federal agency. Local law-

enforcement agencies such as municipal police or the sheriff's office, and the inspectors of the FCC, are prepared to make the proper impressions and certify the same. If you are appearing in person for examination, take the form with you and have the inspector make the impressions. If you are a Class C applicant, and cannot get to an FCC inspector, have it done by a law-enforcement agency such as your local police. Don't forget to sign the fingerprint card in the presence of the certifying official, with the same signature that you use on the questionnaire.

The instruction sheet says that the birth certificate must be based on data filed a short time after birth, but actually a certificate in otherwise satisfactory form will be accepted regardless of the date on which the data were first recorded.

If your birth was recorded but without giving your name, get an affidavit from a parent or any older relative who was in position to know the facts at the time, identifying you as the unnamed baby thus born. Sometimes the Vital Statistics office will itself accept such affidavit and then issue you a birth certificate showing your name. If they do not follow that practice, send both the certificate and the affidavit to the Commission.

If you are a naturalized citizen, you must fully answer the questionnaire but do not need a birth certificate. All they want from you is a complete description of your original naturalization certificate in the reply to Question 6, plus an endorsement by the notary or other official administering the oath, written either on the questionnaire opposite the notary's signature or as a separate addendum, reading approximately as follows:

"I certify that this individual's naturalization certificate is accurately described in the response to Question 6 and that I believe the individual appearing before me is the individual named therein."

### Physical Disability

No physical infirmity, except total deafness, is a bar to the issuance of amateur operator and station licenses, provided the applicant can qualify. An invalid or shut-in who lives more than 125 miles from the nearest examining point will, of course, follow the usual mail procedure specified for the Class C license. But if he lives within the 125-mile limit and is genuinely incapable of traveling, he is similarly entitled under Sec. 12.21 to take the Class C examination and should request papers therefor from his district inspector. The application itself must be accompanied by a physician's certificate stating that the applicant is unable to appear for examination because of protracted disability; and sometimes the inspector will ask to see such a certificate before he will send the Class C envelope to a location where normally only Class B is available. Needless to say, the infirmity must be of a permanent or semi-permanent nature; temporary sickness does not entitle one to exemption from appearance.

Some applicants for license, whether it be Class A, B or C, are unable to write out their own examinations in longhand because of blindness or other disability. In such cases, the Commission will permit the applicant to typewrite or dictate the code test and examination answers. If unable to draw the required diagrams, the applicant may instead give a detailed verbal description of them essentially equivalent. When this practice is observed, the witness or examining officer must certify that the examination comprises solely the applicant's efforts or dictation, and that no outside assistance was rendered. The nature of the disability must also be stated and if the examination was dictated the name and address of the person or persons who took and transcribed the dictation must be noted.

### Renewals

In normal times, both the operator and station licenses may be renewed, simultaneously and with concurrent terms, upon application filed at least 60 days before expiration. The usual procedure has been to keep your expiration date in mind, write your district inspector for an amateur application form, mark it as an application for renewal, and send it direct to FCC in Washington in good season.

However, all this is changed during the war. Operator licenses have been renewed automatically. Station licenses cannot be renewed. The application form has been changed to deal only with new operator licenses. See particulars under "Wartime Changes," on page 9.

### Modifications

The holder of a Class B or C license is eligible to apply for the Class A examination, provided he has held his ticket for at least a year. The holder of Class C is also eligible at any time to go up for his Class B license (thereby eliminating the possibility in future of being called up for personal examination at an inconvenient time and distance) whenever and wherever he can arrange for personal appearance before an inspector. All these cases require personal appearance before an inspector. Qualifying for any such higher grade of license results in reissuing the operator license in "modified" form; in such cases, the term of both the operator and station license is also extended and becomes three years from the date of modification. If you are interested in a higher class of license, communicate with the inspector for your district; you can take your examinations before any inspector in any district, however.

If you change your station's location by moving to another address in the same city, or to another part of the state, or into another state, you must apply for a "modification" to authorize the new address. The procedure for this is the same as an original application except that of course you do not have to pay any attention to



those portions of the application form relating to the operator license. Write your district inspector for the usual amateur application form and fill out the "station" part as usual, except that it is now designated at the top as an application for modification. *Proof of activity is never required in connection with modifications; you can leave this section blank.*

When you have filled out the form, mail it, together with your existing license, to the Federal Communications Commission, Washington, D. C., not to the inspector. Modifications of this type result in extensions of the license period for both operator and station portions; when you get your modified license back you will find it is really a new license running for a full three years.

Of course, if at the same time that you want to change the address of your station it is necessary for any reason for you to take an operator examination before the inspector, you would not mail any of the forms direct to the Commission. You would return them to the inspector and await his instructions when to appear for personal examination. Direct return to the Commission is in order only when no personal appearance is to be required.

When your licenses have been mailed in for modification or renewal of either station or operator privileges, you may continue to operate until the new ticket is received — unless your license expires before that time — with this one exception: if you are modifying to change the station address, the period that you may operate without the station license in your possession must not in any case exceed four months, and portable procedure must be used meanwhile. See Sec. 12.93 (a).

If a Class C amateur moves to a point within one of the 125-mile Class B circles, he may apply for modification to change the address and, employing portable procedure under Sec. 12.93 (a), may continue operating while awaiting modified licenses — up to the theoretical four months. But his case is complicated by the fact that he is also under the necessity of appearing in person at an examining point within four months of moving into the circle and qualifying for Class B, or losing his license. See Sec. 12.45. Since modification of a license actually results in reissuance for a new term of three years, it cannot be expected that FCC will act until he qualifies for Class B — they will put the application on ice and await the exam. Therefore, inevitably, amateurs who wait until late in the four months' period to take the exam will fail to receive new licenses before the authorized operating period expires, and will have to go off the air. The same thing is true of Class C amateurs who have a new examining point opened up within 125 miles airline of them. Such amateurs will therefore be well advised to take the examination as early as possible after moving or after the establishment of a new circle

that contains their location. Another advantage is that if they fail the exam, there will still be time in the four months to try it again.

## Exemptions

Applicants for Class A who hold Class B will be required to pass only the special Class A examination. Class C applicants for Class A will, however, have to take both the B and A tests in full, including a code test.

Applicants for any class of amateur license who within five years have held either a Class A amateur license or certain grades of commercial radiotelegraph or radiotelephone licenses are exempt from certain sections of the amateur examination and should carefully study Sec. 12.46 of the amateur regulations. As will be seen, a Class B or C applicant who holds or has held within five years a commercial extra-first license or any of the three grades of commercial radiotelegraph license is exempted from taking the code test and the technical part of the written examination, and is required to pass only the questions relating to treaties, laws and regulations pertaining to amateur operation. B or C applicants who may have held a Class A or radiotelephone 1st or 2nd license also miss the technical questions but have to take a code test and the questions on regulations. Applicants for Class A who have held commercial extra-first miss the code test and all technical questions, getting only the questions on regulations. However, if such applicants have held only 1st, 2nd or 3d radiotelegraph licenses they have to take the special 'phone technical examination customarily required of Class A applicants, in addition to the questions on rules and regulations, although they are allowed to pass up the code test and the technical questions associated with the Class B examination. For those who within five years have held a radiotelephone 1st or 2d or a Class A amateur license, all technical questions are eliminated; but a code test is required, as are also questions on the regulations.

Previous holding of a commercial third-class radiotelephone license does not entitle an applicant to any credits of any sort and the regular examinations must be taken in all cases.

## Regulations and Orders

Every amateur must be familiar with the FCC regulations. They are printed and indexed at the end of this booklet. Because of the international situation, FCC has also issued a number of temporary orders which, in some cases mentioned in this booklet, temporarily modify some amateur regulations. These orders, too, are to be found at the end of this publication, and the applicant should be familiar with their provisions.

## Passing the Operator Examination

And now to the examination itself. We first take up the Class B and C examination.



The examination consists of about 50 questions. Approximately two-thirds of the questions are on technical subjects; the remainder concern themselves with amateur regulations. For the most part these questions are the quickly answered "multiple-choice" type (explained in detail in the next paragraph) which require merely that the applicant indicate the correct one of several suggested answers. Some of these require simple mathematical calculations, in addition to which there are some questions — not of the multiple-choice type — which also require the solution of simple problems in arithmetic; finally, some of the questions involve the drawing of a requested circuit diagram.

A word about the "multiple-choice" type of query. This is the kind frequently used in current-events quizzes, where a question is asked and four or five possible answers given, one of which, and only one, is correct. In answering such a question, it is necessary only to indicate which is the correct answer; no explanation or comment is required. In the amateur examination, each of the possible answers is numbered, and a space is left at the right-hand side of the sheet in which the applicant puts down the number of the correct answer. Two types of multiple-choice questions, with the correct answer designated in each case, are as follows:

A. San Francisco is located in:

1. Nebraska.
2. New York.
3. Oregon. (Correct answer number
4. California. indicated here)
5. Texas. 4

B. San Francisco is *not* located in:

1. The Western Hemisphere.
2. The United States.
3. North America. (Correct answer number
4. California. indicated here)
5. Canada. 5

Most of the questions in the examination are of this general type, which has been tested and found satisfactory by the Commission through several years' experience with commercial radio operator examinations. As is apparent, the number put down must be either 100% right or 100% wrong. There is no opportunity for part credit on questions; an applicant gets either full credit for correct answer or no credit at all for an incorrect one. For the person who is adequately prepared, an examination of this type is easier than the "essay" type. It is also fairer in that the personal opinion of the examiner cannot enter as a factor; there is thus no possibility of being "docked" part credit because a particular examiner might regard an answer as insufficiently detailed, etc., as could be the case in connection with the essay-type reply.

The questions and answers in this booklet are designed to give you all the knowledge you need to answer correctly the actual examination questions. But it should be emphasized that *the questions we list here are not the actual questions in the license examination*, nor do they correspond question-for-question to similar examination items. What they are, however, are carefully prepared items designed to insure that you have the necessary knowledge to cope with the actual test queries. For instance, the examination might have a question or a problem which involved the use of Ohm's Law to answer properly. Without in any way duplicating that particular problem, or even its type, a question could be devised which made it necessary for the student to learn the use of Ohm's Law to the extent required in the examination. Similarly, if we give a question here requiring that the student draw the diagram of a multi-stage r.f. amplifier, it is a fair assumption he would subsequently be able to draw diagrams of any one of its individual stages.

To the questions asked in this booklet we give carefully considered answers which naturally take the form of brief discussions. Where the subject needs a little more explanation you will find a note appended, as in the questions involving arithmetic, where we show how the computation is made. But bear in mind that your actual examination will be in the multiple-answer form and that you will not have to write out a response but will simply identify the answer you perceive to be correct. There may be several questions in the actual examination revolving around one simple discussion in this manual, but when you understand the subject you can readily check off answers to any number of questions on it. If our answers sometimes seem to the initiated to be naive or incomplete, rest assured that they are sufficient for the purpose. You may similarly encounter several demands for circuit drawing derived from a single one of our drawings, but if you know the whole circuit you know all its parts.

In other words, the purpose of this manual is not to give the student the actual questions he will meet, but to equip him with the knowledge he must have to pass the examination. In order to familiarize himself with the underlying principles, we also suggest a study of *The Radio Amateur's Handbook*, particularly those chapters dealing with elementary electrical and radio principles, basic transmitter, radio-frequency, audio-frequency and power-supply circuits, frequency-measuring and monitoring equipment, and radio-telephony.

The person who can send and receive international code at the required "thirteen-per" and feels confident he can answer any of the questions in this manual need have no fear whatever of the government examination. And in the event of failure, remember that the examination may be taken again after two months have elapsed.

## TEMPORARY CHANGES

**D**URING the war amateur stations were closed by FCC Orders 87, 87-A and 87-B, which withdrew all frequencies. As war approached, and since, additional temporary restrictions and requirements were imposed by various temporary orders to be found on pages 28, 29 and 30 of this booklet. At this writing these orders are still in effect. The student must familiarize himself with them.

However, amateur radio is in the process of reopening and the situation is changing rapidly. The student should keep himself posted on the current status by inquiry of his local radio club, his FCC Inspector, or ARRL. As of 1 September 1945 the following is the situation:

1) Most prewar amateur stations are temporarily authorized to resume transmission in the 2½-meter band, by FCC Order 127 of Aug. 21, 1945, which orders that

... notwithstanding the provisions of Commission Orders 87, 87-A, and 87-B, all amateur radio station licenses which were valid at any time during the period December 7, 1941, to September 15, 1942, and which have not heretofore been revoked be, and they hereby are, reinstated for a period commencing with the date of this order and ending November 15, 1945 (3 A.M., E.S.T.), for the sole purpose of authorizing during that period the operation of such amateur radio stations in the frequency band 112 to 115.5 megacycles by duly licensed amateur operators and in accordance with the Commission's Rules Governing Amateur Radio Stations & Operators.

This band will shortly be changed to 144-148 Mc. Meanwhile it is important that 115.5 Mc. be observed as its upper limit. If the station be no longer located at the address shown on the station license, the portable designator must be added to calls but notice of portable-status operation is not required for this band. Work with WERS stations is not permitted.

2) FCC will shortly resume the issuance of new station licenses, modifications, and

formal renewals of expired licenses, under the general procedure described in this booklet, by means of an additional order — which will also probably repeal most of the temporary restrictive orders mentioned and which will put amateur radio back into "permanent" rather than "temporary" operation. Until that time, no facilities exist for new amateurs to obtain station licenses.

3) Amateur operator licenses may be obtained now as herein described — new, modified or duplicate. A simplified Form 610 application is in temporary use. There is one new question: whether you have ever been convicted of a crime. If so, you are to attach a statement of particulars. Notarization is no longer required. Most amateur operator licenses have been kept alive by automatic extensions (see Orders 115 and 115-A, page 30) and applications for renewal are not necessary until further FCC order. The automatic extension does not apply to a licensee who failed to prove citizenship and file fingerprints (Order 75) or who voluntarily surrendered his license, or whose license has been or in future is suspended by FCC.

4) Additional bands of frequencies will be restored to amateurs by future FCC orders as rapidly as the military services release them.

5) Order 101 (page 29) still requires amateurs possessing transmitters, or other persons having possession of transmitters belonging to amateurs, to apply for Certificates of Registration. Order 99 makes similar demand upon persons not yet holding a valid station license. Forms are obtained from the district Inspector but are sent to FCC at Washington.

6) Prewar station calls will be preserved for former holders, so far as possible; subject, however, to some probable rearrangement of call areas.

# The Radio Amateur's

## Questions and Answers for the Amateur Examinations

### FOR CLASSES B AND C

1. Name the basic units of electrical resistance, inductance, capacitance, current, electromotive force or potential difference, power, energy, quantity, magneto-motive force, and frequency.

The unit of electrical resistance is the ohm.

The unit of inductance is the henry.

The unit of capacitance is the farad.

The unit of current is the ampere.

The unit of electromotive force or potential difference is the volt.

The unit of power is the watt.

The unit of energy is the joule.

The unit of quantity is the coulomb.

The unit of magneto-motive force is the gilbert.

The unit of frequency is cycles-per-second or, simply, cycles.

2. Name the instruments normally used to measure (a) electric current; (b) potential difference; (c) power; (d) resistance; (e) frequency.

(a) Electric current is measured by an ammeter; (b) potential difference by a voltmeter; (c) power by a wattmeter; (d) resistance by an ohmmeter; and (e) frequency by a frequency-meter.

3. How may plate power input of an amplifier be determined when the plate voltage and plate current are known?

The plate power input of an amplifier in watts is equal to the product of the plate voltage in volts and the plate current in amperes.

*Note:* For example, the power input to an amplifier operating at a plate voltage of 1000 volts with plate current of 125 milliamperes (0.125 ampere) would be 125 watts.

4. Explain the purpose of using a center-tap return connection on the secondary of a transmitting tube's filament transformer.

A center-tap return connection for the grid and the plate circuit is provided on the secondary of a transmitting tube's filament transformer to prevent modulation of the emitted wave by the alternating-current filament supply.

5. If the high-voltage secondary of a plate transformer was changed from a full-wave center-tapped to a bridge rectifier connection, what would be the relative voltage and current output ratings as compared to those for the full-wave center-tapped connection?

With the bridge connection the output-voltage rating would be double while the current rating would be half that for the center-tapped connec-

tion. In consequence, filter condensers of twice the voltage rating would be required for the bridge connection, while the filter choke might have one-half the current rating for full output.

6. Why is it advisable to use a plate power supply for the oscillator of a transmitter separate from the final amplifier plate power supply?

It is advisable to use a separate plate power supply for the oscillator because frequency modulation of the emitted carrier is likely to occur with a power supply common to the oscillator and other stages of the transmitter — because of plate-voltage variations with changing load.

7. How does a swinging choke operate to improve the voltage regulation of a plate-supply filter system?

The swinging choke provides increased inductance with decreasing load current, thus tending to keep the output voltage constant with varying load.

8. Why is full-wave rectification generally preferable to half-wave rectification in a power supply?

Full-wave rectification is generally preferable because the output is easier to filter as a consequence of the higher ripple frequency.

9. What are the relative advantages and disadvantages of mercury-vapor and high-vacuum rectifiers of equivalent filament ratings?

The mercury-vapor rectifier has a lower internal voltage drop of nearly constant value, along with a relatively high current rating. However, the mercury-vapor rectifier also has a critical inverse peak voltage rating and a critical peak-current rating which must not be exceeded in operation. Because of the critical peak-current rating it is not advisable to use mercury-vapor type tubes with condenser-input filters. On the other hand, while the high-vacuum type rectifier has a greater internal voltage drop, the inverse peak-voltage rating is limited only by the insulation within the tube and it does not have a critical peak-current rating, so that it may be used safely with a condenser-input filter.

10. What are the principal output-voltage ripple frequencies with half-wave and full-wave single-phase rectifiers, in terms of the a.c. supply frequency?

With a half-wave rectifier, the principal output ripple frequency is equal to the alternating-current supply frequency; while with a full-wave single-phase rectifier the principal output ripple frequency is twice the a.c. supply frequency.



11. What is the principal reason for using a filter in a plate power-supply system?

The principal reason for using a filter in a plate power-supply system is to smooth out the a.c. ripple component in the output and make it "pure d.c."

12. What would be a suitable type and the approximate capacitance of the filter condensers in a typical 1000-volt transmitter plate-supply system?

Suitable types of filter condensers would be paper, oil-filled, or pyranol types of 2- to 4- $\mu$ f. capacitance with a working voltage of more than 1000 volts.

13. What would be the visible operating results of a short-circuited filter condenser in a plate power supply with an unfused primary circuit?

With high-vacuum type rectifier tubes the plates would become red hot, while with mercury-vapor rectifiers the normal bluish-green glow would become considerably brighter.

14. Why should a fuse be used in the transformer primary circuit of a power-supply system?

A fuse should be used in the transformer primary circuit to prevent damage to the power supply from overload.

15. Why is a bleeder resistor connected across the output circuit of a high-voltage power-supply system?

A bleeder resistor is used to give better voltage regulation by providing a minimum fixed load on the power supply.

16. What would happen if the primary of a 60-cycle power supply was connected to mains carrying continuous direct current?

With d.c. applied, excessive current would flow in the primary winding of the power transformer.

17. What is the principal advantage of a screen-grid type r.f. amplifier tube over a triode of equal output rating?

The principal advantage of the screen-grid type tube is that it does not require an external neutralizing circuit because the screen-grid reduces the effective capacitance between the control grid and plate to a very small value.

18. What tube rating indicates the maximum safe heat radiation capability of the anode of a vacuum tube?

The maximum safe heat radiation capability of the anode is indicated by the "maximum plate dissipation" rating, expressed in watts.

19. In the classification of tubes according to the number of elements, how many grids has each of the following types: (a) diode; (b) triode; (c) tetrode; (d) pentode; (e) heptode?

(a) Diode, no grid; (b) triode, one grid; (c)

tetrode, two grids; (d) pentode, three grids; (e) heptode, four or five grids, depending upon the type.

*Note:* For each type, with the possible exception of the heptode, the number of grids is two less than the total number of elements in the tube as indicated by the general type name. The diode has two elements; the triode, three elements; the tetrode, four elements; the pentode, five elements; and the heptode, seven elements.

20. Describe the adjustment procedure for proper neutralization in a radio-frequency power amplifier using an r.f. indicator coupled to the plate tank circuit.

The adjustment procedure for proper neutralization is as follows: The plate voltage is first removed from the tube or tubes of the stage to be neutralized. This is an especially important precaution, because the amplifier cannot be neutralized with plate voltage applied. The input and output circuits are then tuned to resonance with the excitation frequency, as indicated by maximum reading of the r.f. indicator coupled to the plate tank circuit. The neutralizing condenser or condensers are then adjusted, while the input and output circuits are tuned to resonance, until the r.f. indicator shows that there is no r.f. power in the plate tank circuit.

21. Why is it necessary to neutralize a triode radio-frequency power amplifier operating with input and output circuits tuned to the same frequency?

The triode r.f. amplifier must be neutralized to prevent self-oscillation.

22. What undesirable effects may result from operation of an unneutralized triode r.f. amplifier in a transmitter?

Self-oscillation may result, with consequent radiation on undesired frequencies, possibly outside an amateur band.

23. What undesirable effects result from frequency-modulation of an amplitude-modulated carrier wave?

Frequency modulation causes spurious sidebands ("broad signals") and unnecessary interference.

24. What operating conditions would be favorable for harmonic generation in a radio-frequency doubler or frequency-multiplying amplifier?

Operating conditions encouraging harmonic generation are high negative-grid bias, with ample excitation, and a high-impedance plate circuit tuned to twice the excitation frequency (one-half the wavelength of the excitation voltage).

25. Where is link coupling applicable in an oscillator-amplifier type transmitter?

Link coupling may be used between the oscillator and buffer stage, between two r.f. amplifier

stages, or between the output stage and the antenna coupling network.

26. What is the purpose of a Faraday (electrostatic) shield between the output circuit of an r.f. power amplifier and antenna coupling system?

A Faraday (electrostatic) shield is used to reduce undesirable harmonic transfer and radiation which otherwise might result from capacitive coupling.

27. What are the output circuit conditions for obtaining optimum power output from a radio-frequency amplifier?

Optimum power output is obtained when the output circuit impedance is matched to the rated tube load impedance.

Note: Optimum power output is the maximum power obtainable with reasonably good efficiency and reasonably small distortion (low harmonic content).

28. In which stage of a transmitter is an amplifier of high harmonic output least desirable?

An amplifier of high harmonic output is least desirable in the output stage of a transmitter because radiation of spurious harmonic frequencies may result, especially when the tank circuit is directly coupled to the antenna system.

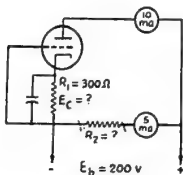
29. What are the relative plate current indications for resonance and off-resonance tuning of the plate tank circuit of a radio-frequency power amplifier?

The plate current is minimum at resonance and rises suddenly to an excessive value at off-resonance tuning.

30. What are the advantages of a push-pull r.f. power amplifier output stage as compared to a single-ended stage of the same power?

One advantage of a push-pull r.f. amplifier is that even harmonics of the excitation frequency are suppressed by cancellation in the output circuit. Another is that more complete neutralization usually can be obtained than with a single-ended amplifier.

31. In the circuit diagram below, what is the value of the bias voltage? What is the value of the bleeder resistance,  $R_2$ ?



(O 31)

## The Radio Amateur's

The bias voltage,  $E_b$ , is 3 volts.

The value of the bleeder resistance,  $R_2$ , is 40,000 ohms.

Note: The cathode current is the same as the plate current.

Hence,  $I_c = 10 \text{ ma.} = 0.01 \text{ amp.}$

By Ohm's Law,  $E_c = I_c R_1 = 0.01 \times 300 = 3 \text{ volts}$

Also by Ohm's Law,  $R_2 = \frac{E_b}{I_b} = \frac{200}{0.005} = 40,000 \text{ ohms}$

where  $I_b$  is the bleeder current = 5 ma. = 0.005 amp.

32. A certain 1750-kc. Y-cut quartz crystal has a positive temperature coefficient of 125 cycles per degree Centigrade and is started in operation at 40 degrees Centigrade. If the temperature-frequency characteristic is linear, what will the oscillation frequency be at a temperature of 60 degrees Centigrade?

The final oscillation frequency is 1752.5 kc.

Note: "Positive temperature coefficient" means that the oscillation frequency *increases* with rise in temperature. The total change in temperature is  $60^\circ - 40^\circ = 20^\circ \text{ C.}$  The total frequency increase is therefore  $125 \times 20 = 2500 \text{ cycles per second, or } 2.5 \text{ kc.}$  The final oscillation frequency is  $1750 \text{ kc.} + 2.5 \text{ kc.} = 1752.5 \text{ kc.}$

33. A 2000-kc. low-drift crystal having a negative temperature coefficient of 5 cycles per megacycle per degree Centigrade is started in operation at 40 degrees Centigrade. If the temperature-frequency characteristic is linear, what will the oscillation frequency be at a temperature of 60 degrees Centigrade?

The oscillation frequency at 60 degrees Centigrade is 1999.8 kc.

Note: "Negative temperature coefficient" means that the oscillation frequency *decreases* with rise in temperature. "5 cycles per megacycle" means 5 cycles per megacycle of the specified calibration frequency of the crystal (in other words, 5 parts per million).  $1 \text{ Mc.} = 1000 \text{ kc.}$  The total frequency decrease is therefore  $5 \times 2 \times (60 - 40) = 200 \text{ cycles} = 0.2 \text{ kc.}$  The final oscillation frequency is therefore  $2000 \text{ kc.} - 0.2 \text{ kc.} = 1999.8 \text{ kc.}$

34. A low-drift crystal for the 3500-4000 kc. amateur band is guaranteed by a manufacturer to be calibrated to within 0.04% of its specified frequency. Desiring to operate as close to the lower band limit of 3500 kc. as safely as possible, for what whole-number kilocycle frequency should you order your crystal, allowing 1 kc. additional for variation from temperature and circuit constants?

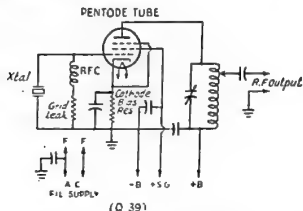
The crystal should be ordered for a frequency of 3503 kc.





38. Draw a simple schematic diagram of a half-wave rectifier with a filter which will furnish pure d.c. at highest voltage output, showing filter condensers of unequal capacitance connected in series, with provision for equalizing the d.c. drop across the different condensers.

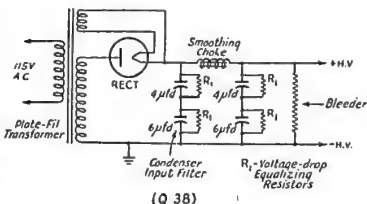
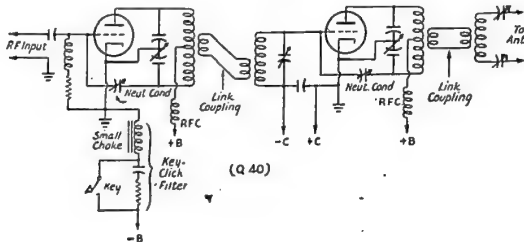
39. Draw a simple schematic diagram of a piezo-electric crystal-controlled oscillator using a pentode vacuum tube, indicating polarity of electrode supply voltages where externally connected.



*Note:* The circuit for a tetrode (four-element) tube would be the same except that the suppressor grid would be omitted. For a triode oscillator, both the suppressor and screen grid would be omitted, as would also be the screen-grid supply-voltage terminal indicated on this pentode diagram.

40. Draw a simple schematic diagram of two r.f. amplifier stages using triode tubes, showing the neutralizing circuits, link coupling between stages and between output and antenna system, and a keying connection in the negative high-voltage lead including a key-click filter.

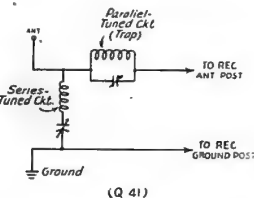
41. Draw a schematic diagram of a filter for reducing amateur interference to broadcast reception consisting of a series-tuned circuit connected in shunt with the b.c. receiver input to by-pass the interfering signal and a parallel-tuned (trap) circuit in series with the receiver input to reject the interfering signal.



42. Draw a schematic diagram of a pentode audio power-amplifier stage with an output coupling transformer and load resistor, showing suitable instruments connected in the secondary for measurement of the audio-frequency voltage and current, and naming each component part.

43. What is the principal purpose of using door interlock switches on a transmitter?

Door interlock switches are used on a transmitter to prevent the operating personnel from accidentally being shocked by dangerous high voltages.

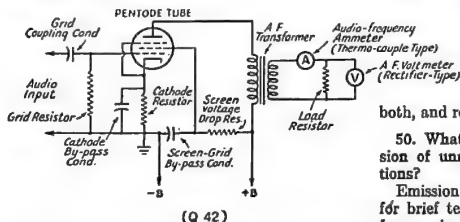


44. What is the usual means for protecting amateur station equipment from damage by charges of atmospheric electricity on the antenna system?

The usual means for protecting amateur station equipment is an antenna grounding switch.

45. What is a safe procedure for removing an unconscious person from contact with a high-voltage circuit?

The safe procedure is first to open the main switch of the high-voltage power supply and then remove the victim from contact with the high-voltage circuit. No direct contact should be made with any part of the victim's body until the high-voltage switch has been opened.



46. Using a frequency meter with a possible error of 0.75%, on what whole-number kilocycle frequency nearest the high-frequency end of the 3500-4000 kc. amateur band could a transmitter safely be set?

The frequency is 3970 kc.

Note: The formula for precise calculation of the frequency indicated by the meter is

$$f_s = \frac{fu}{1+n}$$

where  $f_s$  is the indicated frequency

$fu$  is the upper band-limit frequency

$n$  is the specified percentage error, expressed as a decimal.

In this case

$$f_s = \frac{4000}{1.0075} = 3970.2 \text{ kc.}$$

47. Using a frequency meter with a possible error of 0.75%, on what whole-number kilocycle frequency nearest the low-frequency end of the 7000-7300-kc. amateur band could a transmitter safely be set?

The whole-number kilocycle frequency nearest the low-frequency end of the band on which the transmitter may be safely set is 7053 kc.

Note: The formula for precise calculation of the frequency indicated by the meter is

$$f_s = \frac{f_L}{1-n}$$

where  $f_s$  is the frequency indicated by the meter

$f_L$  is the lower-limit frequency of the band

$n$  is the specified percentage error, expressed as a decimal.

In this case,

$$f_s = \frac{7000}{1-0.0075} = \frac{7000}{0.9925} = 7052.9 \text{ kc.}$$

48. What radio messages have priority over all other communications?

Distress calls and distress communications

have absolute priority over all other communications. [Communications Act, Sec. 321(b) and General Regulations, Sec. 2.59]

49. What is the penalty for willful or malicious interference with other radio communications?

A fine of up to \$500 for each day during which the offense occurs, and suspension of operator license. However, if the willful interference is in connection with distress communications, there may be added a fine of up to \$10,000 or imprisonment up to two years, or both, and revocation of station license.

50. What is the FCC rule regarding emission of unmodulated carriers by amateur stations?

Emission of an unmodulated carrier (except for brief tests or adjustments) is prohibited on frequencies below 112,000 kc. [Amateur Regulations, Sec. 12.134]

51. On what amateur bands is portable operation permitted without prior notification to the inspector of the district in which such operation is contemplated?

Under the Amateur Regulations, Sec. 12.92, on all frequency bands above 28,000 kc. Under the temporary restrictions of Order No. 73, only on all frequency bands above 56,000 kc.

52. When may third-party messages be handled between amateur stations of different countries?

Normally, third-party messages may be handled between amateur stations of different countries only when such exchange has been authorized by special agreement between the countries concerned. However, all foreign communication by U. S. amateurs is temporarily forbidden by Order No. 72, q.v.

53. What period of each hour shall be used for making important initial calls when a state of communications emergency has been proclaimed by the FCC?

Initial emergency calls of course may be made at any time, but during the first five minutes of each hour during an emergency all other stations on the 1750-2050 and 3500-4000 kc. bands are obliged to listen for such calls, so that is the most favorable period for attracting attention. [Amateur Regulations, Sec. 12.155(e)]

54. When does a state of emergency affecting amateur communications become effective and when is it terminated?

When so ordered by FCC [Amateur Regulations, Sec. 12.155 and 12.155(e)]

55. What amateur bands are affected and what frequencies are reserved for emergency calling when a state of communications emergency has been proclaimed by the FCC?

Amateurs should read and be familiar with all the provisions of the emergency regulation, Sec. 12.155. The amateur bands affected are the 1750-2050 kc. and the 3500-4000 kc. bands. When an emergency has been proclaimed, these bands may be used *only* for emergency communications, and all incidental calling, testing and casual conversation are prohibited. Furthermore, within these bands, the frequencies 2025-2050, 3500-3525 and 3975-4000 kc. are then reserved for emergency calling.

56. On what frequencies may a licensee holding Class B amateur privileges operate an amateur radiotelephone station?

Correct answer now depends upon where you live: In the Continental United States, it is on the frequencies 1900-2050 kc., 7250-7300 kc. and all frequencies above 28,100 kc. In U. S. territories and possessions, 1800-2050 kc. and all frequencies above 28,100 kc. [See "Temporary Rearrangement of Frequencies," page 29, Temporary Sec. 12.155 of amateur regulations, therein.]

57. What is the FCC regulation regarding transmission of music by an amateur radiotelephone station for testing purposes?

It is prohibited. [Amateur Regulations, Sec. 12.104]

58. What is the highest modulation percentage of an amateur radiotelephone transmitter permitted by FCC regulations and under what condition may it be employed?

One hundred percent modulation is the highest permitted, and then only when means have been employed to insure that this percentage is not in excess of the modulation capabilities of the transmitter. [Amateur Regulations, Sec. 12.133]

59. What power input should an amateur station use for a particular communication when the maximum legal input is 1 kw.?

The minimum input necessary to maintain the desired communication. [Communications Act, Sec. 324]

60. On what amateur bands is portable operation permitted only when prior notification has been given to the FCC inspector in charge of the district in which such operation is contemplated?

Under the Amateur Regulations, Sec. 12.92, on all frequencies below 14,400 kc. (not necessary for the bands above 28 Mc.). Under the temporary restrictions of Order No. 73, on all frequencies below 30,000 kc. (not necessary for the bands above 56 Mc.).

61. On what amateur bands is adequately-filtered direct-current plate power supply required for operation of an amateur transmitter?

On all frequencies below 60,000 kc. [Amateur Regulations, Sec. 12.132]

62. On what amateur bands is adequately filtered d.c. plate power supply *not* required for operation of an amateur transmitter?

On all frequencies above 112,000 kc.:

112,000 to 116,000 kc.

224,000 to 230,000 kc.

400,000 to 401,000 kc.

(And whenever working above 300,000 kc.)

[Amateur Regulations, Sec. 12.132]

63. What is the maximum permissible plate power input to the final stage of an amateur transmitter and under what circumstances may it be used?

The maximum input permitted at any time is 1 kilowatt, but this may be used only when means are provided for measuring it accurately; if accurate measuring facilities are not available, the maximum permissible is 900 watts. [Amateur Regulations, Sec. 12.131]

64. How would a short-circuited turn of the coil affect the resonance frequency of a tuned circuit, and why?

A short-circuited turn would increase the resonance frequency of the tuned circuit because the inductance would be reduced.

65. What is meant by the harmonic of a fundamental frequency?

The harmonic of a fundamental frequency is a frequency which is an integral multiple (2, 3, etc., times) the fundamental frequency, the fundamental being considered the first harmonic. A frequency twice the fundamental frequency is the second harmonic, one three times the fundamental frequency is the third harmonic, etc. For instance, the third harmonic of 4000 kc. is  $3 \times 4000 = 12,000$  kc.

66. What operating characteristics distinguish the electron-coupled type oscillator with regard to frequency stability?

The electron-coupled type oscillator generally has better frequency stability with varying load conditions and operating voltages than other types of self-controlled oscillators, although it is not so stable under all conditions as a crystal-controlled type oscillator.

67. What circuit conditions will minimize the harmonic components in the output circuit of a given radio-frequency amplifier stage?

Harmonic components will be minimized by a large capacitance-to-inductance ratio in the plate tank circuit, along with grid bias not much greater than cut-off value and the minimum excitation voltage for reasonably good efficiency.

68. Give the meanings of the following "Q" signals: QRK, QRM, QRT, QRX, QSA, QSY, QSZ.

QRK: The legibility of your signals is . . . (1 to 5).



- QRM: I am being interfered with.  
 QRT: Stop transmission.  
 QRX: Wait (or Wait until I have finished communicating with . . . ). I shall call you again at . . . o'clock (or immediately).  
 QSA: The strength of your signals is . . . (1 to 5).  
 QSY: Shift to transmission on . . . kc/s (or . . . m.) without changing the type of wave.  
 QSZ: Transmit each word or group twice.

## EXAMINATION FOR CLASS A

The subjects so far treated in this booklet are all that one has to know to pass the examination for the ordinary amateur license of *Class B* or *C*. Such license permits c.w. telegraph operation in every amateur band and 'phone operation in the bands 1800-2050, 28,100-30,000, 56,000-60,000, 112,000-116,000 and 224,000-230,000 kc. and on all frequencies above 300,000 kc. However, to engage in 'phone transmission in the more desirable bands 3900-4000 and 14,150-14,250 kc., additional authorization is needed, which may be had only by passing the *Class A* examination.

To be eligible to apply, the applicant must have had at least one year's experience as a licensed amateur operator within the five years preceding application. If he is thus eligible but at the moment does not possess a *Class B* license, the *Class A* examination consists of the questions forming the *Class B* examination plus about forty advanced questions dealing exclusively with amateur radiotelephony. In fact, even the holder of a *Class C* license must, if he aspires to *Class A*, appear before an inspector and take the *Class B* examination, including the code test — as well as the *Class A*. But if the applicant has had his year's experience (within the preceding five years) and already possesses a *Class B* license, the examination consists only of the forty-odd additional questions on radiotelephony.

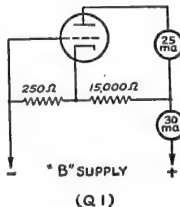
The *Class A* examination resembles the *Classes B & C* in form, consisting of some forty questions, mostly of the "multiple-choice" type but including also some requiring simple calculations and others necessitating the drawing of circuit diagrams. See our discussion of this preceding the questions for *B & C*. As with our questions for the examination for *Class B* and *C*, the following questions are not the actual ones in the test but are representative, and familiarity with them constitutes adequate preparation, although we again recommend study of theory in *The Radio Amateur's Handbook*, particularly the chapter on radiotelephony.

The examination for *Class A* is given only upon personal appearance. Applicants who reside within continental United States, Puerto Rico or the Territory of Hawaii, must appear in person before an examining officer at any of the examining points listed on page 3. Applicants in Alaska

may make an appointment with the Inspector at Juneau (address inquiries to P. O. Box 2719) or can make arrangements with any Army official to secure the sealed envelope for this examination from the inspector and administer the test. In Guam, the Naval District Communications Officer at Agaña is authorized to give the examination.

### 1. In the diagram below:

- What is the d.c. plate voltage?
- What is the d.c. grid bias?
- What is the supply voltage?



- 75 volts.
- 7.5 volts.
- 82.5 volts.

*Note:* The bleeder current through the 15,000-ohm resistor is the difference between the total supply current and the plate current, 30 ma. — 25 ma. = 5 ma. By Ohm's Law,  $E = IR$ ; the voltage across this resistor is therefore  $0.005 \times 15,000 = 75$  volts. This is the d.c. plate voltage (voltage between plate and cathode).

The total supply current (plate current plus bleeder current = 30 ma.) flows through the 250-ohm resistor. The drop across this resistor is therefore  $0.030 \times 250 = 7.5$  volts. This is the d.c. grid bias voltage (voltage between grid and cathode).

The supply voltage is the sum of the voltage drops across the two resistors, or  $75 + 7.5 = 82.5$  volts.

2. What undesirable effects may result from a self-oscillating buffer amplifier in a transmitter? Self-oscillation of a buffer amplifier may cause the emission of spurious frequencies.

3. What type amplifier and class of operation is usually preferred for a frequency doubler? A single-ended type amplifier operating *Class C* is usually preferred.

4. Why is it advisable to use a separate plate-power supply for the oscillator of a multi-stage transmitter?

A separate plate-power supply for the oscillator minimizes plate-voltage variation and thus provides a higher degree of frequency stability.

5. What is the most useful operating characteristic of a "push-push" type of amplifier?

The principal output frequency is twice the excitation frequency. Hence the "push-push" type of amplifier, with the grids of two tubes connected push-pull and the plates in parallel, can be used as a frequency doubler.

6. What are the operating characteristics of the electron-coupled type oscillator with regard to frequency stability?

The electron-coupled type oscillator has better frequency stability with varying supply voltages and load conditions than other types of self-controlled oscillators.

7. What circuit conditions will minimize the harmonic components in the output of a r.f. power amplifier?

A large capacitance-to-inductance ratio in the plate tank circuit, along with relatively low grid bias and the minimum excitation voltage necessary for reasonably good efficiency, will minimize harmonic output.

8. What is the principal disadvantage of using a grid leak as the only source of bias in a Class-C r.f. power-amplifier stage?

Loss of excitation will cause loss of grid bias and an increase in the plate current.

9. What are the relative merits of triodes and screen-grid tubes as r.f. amplifiers?

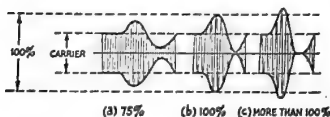
Although triodes are generally more easily loaded and are better adapted to plate modulation, they require an external neutralizing circuit to prevent feed-back and self-oscillation while screen-grid tetrodes and pentodes normally do not require neutralization because their internal grid-plate capacitance is sufficiently reduced by the screen-grid.

10. Show by a diagram the sinusoidal modulation envelope of an amplitude-modulated wave:

(a) Modulated approximately 75%.

(b) Modulated 100%.

(c) Modulated more than 100%.



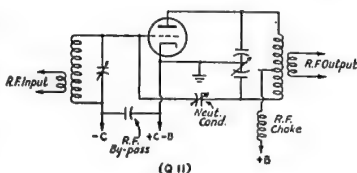
(Q 10)

11. Draw a diagram of a plate-neutralized triode r.f. amplifier stage.

12. Draw a diagram of a coupling system between two audio-frequency amplifier stages, employing resistance elements.

13. What are the principal reasons for using a choke-input type filter in a power-supply system employing mercury-vapor rectifier tubes?

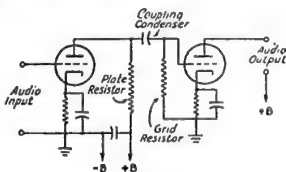
The principal reasons for using a choke-input type filter are to obtain good voltage regulation and to limit the peak current through the rectifier tubes.



(Q 11)

14. Would mercury-vapor or high-vacuum type rectifier tubes of equivalent ratings be preferable for a power supply in which filament and plate voltages must be applied simultaneously? Give the reason for your choice.

High-vacuum type rectifier tubes would be preferable because plate voltage may be applied safely without time delay for the filaments to reach operating temperature.



(Q 12)

15. What visible operating characteristic distinguishes mercury-vapor rectifiers?

The mercury-vapor tubes show a bluish-green glow when operating normally under load.

16. Why are mercury-vapor type rectifier tubes more critical as to observance of anode voltage rating than high-vacuum type rectifiers?

The mercury-vapor tubes have a critical peak inverse voltage rating which must not be exceeded in operation, while with the high-vacuum type rectifier the peak inverse voltage is limited only by the insulation of the tube.

17. What advantage has a push-pull audio-frequency amplifier over a single-tube Class-A amplifier of similar excitation requirement and equal power output?

Even harmonics are not generated in the output circuit of a properly balanced push-pull amplifier.

18. What are the distinguishing operating characteristics of a Class-A type amplifier?

In a Class-A amplifier the grid bias is adjusted for operation over the linear range of the grid-voltage plate-current curve so that the output is a faithful reproduction of the input voltage wave form. The average plate current remains constant. The grid normally is not driven positive. Hence the grid draws no current. The plate efficiency is relatively low.

19. What improper operating conditions are indicated by upward or downward fluctuation of Class-A amplifier plate current when signal voltage is applied to the grid? What correction should be made?

Upward fluctuation of Class-A amplifier plate current with excitation indicates excessive negative grid bias; hence, the grid bias should be decreased. Downward fluctuation of plate current with excitation indicates insufficient negative bias; hence, the bias voltage should be increased to correct this condition.

20. Why is bias voltage generally necessary on the grid of an audio amplifier tube, and what is the principal result of improper bias?

A negative grid-bias voltage is generally necessary to obtain operation over the proper portion of the grid-voltage plate-current characteristic curve of the amplifier tube. Improper bias results in distortion of the wave form in the output of the amplifier.

21. What improper operating conditions are indicated by grid-current flow in a Class-A amplifier?

Grid current flow in a Class-A amplifier indicates either excessive excitation voltage or low negative grid bias, or a combination of both.

22. What is the principal advantage of a Class-B audio amplifier as compared to other types?

Because of its higher efficiency at maximum output and its low plate-power consumption when idling, the Class-B audio amplifier is more economical of power than a Class-A type amplifier. Because of its relatively low distortion it is, of course, preferable to a Class-C audio amplifier.

23. How should the average plate current vary in a properly-designed and operated amplitude-modulated radio-frequency power amplifier?

The average plate current of the modulated r.f. amplifier should remain constant with any constant-carrier system, regardless of the method of modulation.

24. What are the notable efficiency and distortion characteristics of a Class-B modulator employing two triodes in push-pull?

The outstanding characteristic of the Class-B modulator is its high efficiency in combination with relatively small distortion.

25. How do the excitation requirements of a Class-B modulator compare with those of a

Class-A modulator having equal grid-voltage swing?

The Class-B modulator requires greater driver power because the grids are swung considerably positive and draw current on the excitation peaks.

26. What would happen if the grid-bias supply of a Class-B modulator was suddenly short-circuited?

The loss of grid bias resulting from the short circuit would cause the plate current to jump to an excessively high steady value and damage to the tubes might result if the plate dissipation was sufficient to cause the tubes to show abnormal color.

27. What is the ratio of modulator audio power output to Class-C amplifier unmodulated plate power input in a plate-modulation system:

- With a sinusoidal signal?
- With a two-tone signal equivalent to speech?
- 50% with sinusoidal audio power.
- Approximately 25% with a complex signal equivalent to speech.

28. Define amplitude modulation.

Amplitude modulation is the process by which the amplitude of the radio-frequency carrier wave is varied in accordance with the amplitude of the speech or other signal to be transmitted.

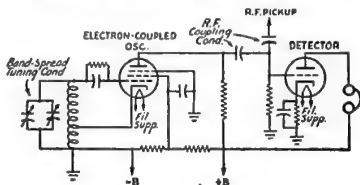
29. What are sideband frequencies?

Sideband frequencies are frequencies above and below the carrier frequency, and equal to the sum and difference of the modulation and carrier frequencies, which are produced by the process of modulation.

30. What radiotelephone transmitter operating deficiencies might be indicated by downward deflection of the antenna r.f. current meter during modulation of the final r.f. amplifier?

Downward deflection of the antenna r.f. ammeter might indicate insufficient r.f. excitation to the modulated r.f. stage, inadequate filament emission in the tubes of the modulated r.f. amplifier, or very poor voltage regulation of a power supply common to both modulator and r.f. amplifier.

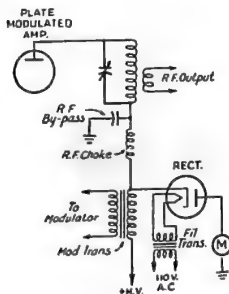
31. Draw a schematic diagram of a combination heterodyne frequency meter and monitor.



(Q 31)

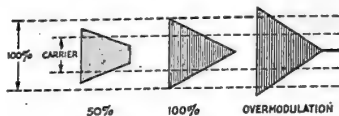


32. Draw a simple schematic diagram of a peak modulation monitor which will indicate when 100% modulation occurs or is exceeded.



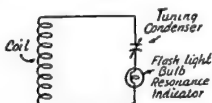
(Q 32)

33. Draw the trapezoidal type patterns showing 50% modulation, 100% modulation and over-modulation as they would appear on the screen of a cathode-ray oscilloscope properly connected to a 'phone transmitter.



(Q 33)

34. Draw a diagram of an absorption-type frequency meter including a resonance indicator.



(Q 34)

35. Draw a simple schematic diagram of a radio-frequency doubler stage driving a neutralized push-pull power amplifier using triodes, showing the method of interstage coupling and indicating the relative resonance frequencies of the grid and plate circuits.

36. Draw a schematic diagram of a two-stage r.f. amplifier using screen-grid tubes, showing a suitable method of interstage coupling.

37. Using a frequency meter with a possible error of 0.75%, on what whole-number kilocycle

frequency nearest the low-frequency end of the 14,000-14,400-kc. band could a transmitter safely be set?

The whole-number kilocycle frequency nearest the low-frequency end of the 14,000-14,400-kc. band is 14,106 kc.

Note: For precise calculation of the frequency on which the transmitter can be set with a given percentage tolerance, the formula to be used is

$$f_s = \frac{f_L}{1 - n}$$

where  $f_s$  is the frequency on which the transmitter is to be set

$f_L$  is the lower-limit frequency of the band

$n$  is the given percentage error expressed as a decimal

For this question, the equation is

$$f_s = \frac{14,000}{1 - 0.0075} = \frac{14,000}{0.9925} = 14,105.8$$

The nearest whole-number kilocycle frequency which will be safely within the band for this tolerance is 14,106 kc.

38. Using a frequency meter with a possible error of 0.75%, on what whole-number kilocycle frequency nearest the high-frequency end of the 14,000-14,400-kc. band could a transmitter safely be set?

The whole-number kilocycle frequency nearest the high-frequency end of the band is 14,292 kc.

Note: The formula for calculating the precise frequency on which a transmitter may be set nearest to the high-frequency end of the band for a given percentage tolerance is

$$f_s = \frac{f_U}{1 + n}$$

where  $f_s$  is the frequency on which the transmitter is to be set

$f_U$  is the upper limit of the band in kilocycles

$n$  is the percentage tolerance expressed as a decimal

For the present question,

$$f_s = \frac{14,400}{1.0075} = 14,292.8$$

The nearest whole-number kilocycle frequency safely inside the band for this percentage tolerance is 14,292 kc. (not 14,293 kc.).

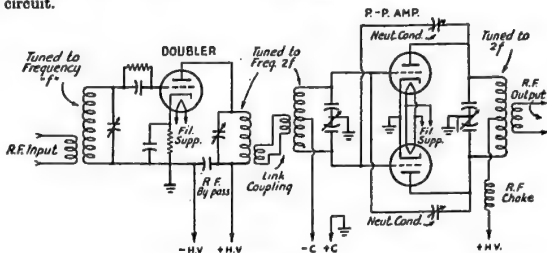
39. What particular precaution should be observed in using a battery-operated heterodyne frequency meter?

The "A" and "B" battery voltages should be checked because a change in battery voltage will affect the oscillator frequency.

40. What particular precaution should be taken in using an absorption-type frequency meter to check a self-excited oscillator?

The frequency meter should be very loosely coupled to the oscillator tank circuit so that the frequency calibration of the meter will be affected as little as possible by mutual coupling to the transmitter circuit.

45. What would be the visible results of a short-circuited filter condenser in a plate power supply with high-vacuum rectifier tubes and an unfused primary circuit?



(Q 35)

41. What are the undesirable operation characteristics of a Y-cut crystal and what precautions should be taken when it is to be used for transmitter frequency control?

The Y-cut crystal has a relative large temperature-frequency coefficient and tends to jump frequency in steps when the temperature varies. A Y-cut crystal also may have two fundamental frequencies fairly close to each other. For this reason, the crystal should be checked for double-frequency resonance in the oscillator circuit before the transmitter is put into operation.

42. What is the purpose of using a quartz crystal in a transmitter?

The quartz crystal determines and stabilizes the oscillator frequency.

43. What are the desirable operating characteristics of an A-cut crystal?

The A-cut crystal has high output capability and a small temperature-frequency coefficient.

44. What particular physical characteristic distinguishes an X-cut crystal from Y- and A-cut crystals of the same frequency?

The X-cut crystal is thicker for a given frequency than either the Y-cut or A-cut type.

The rectifier tube plates would become red-hot in operation.

46. What precaution should be taken to protect filter condensers connected in series?

Resistors having a value of approximately 100,000 ohms should be shunted across each condenser to equalize the d.c. voltage drops and thus prevent breakdown of the individual capacitors.

47. Why is a full-wave rectifier preferable to a half-wave rectifier?

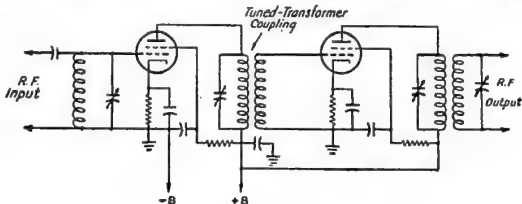
The full-wave rectifier output is easier to filter because of its higher ripple frequency.

48. Two filter chokes have the same inductance, current and insulation voltage ratings but one has twice the resistance of the other. Which would be preferable for use in a transmitter power supply and why?

The filter choke with the lower resistance would be preferable because the output voltage would have better regulation than with the higher-resistance choke.

49. What constructional precaution should be taken to insure stable operation of a transmitter having one or more neutralized amplifier stages?

Isolation of the stages from each other should be provided, either by interstage shielding or



(Q 36)

adequate physical separation of the individual stages.

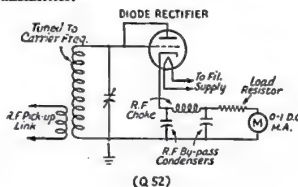
50. Explain the purpose of using a center-tap return connection on the secondary of a transmitting tube's filament transformer.

The filament center-tap connection is used to prevent modulation of the emitted carrier by the alternating-current filament supply.

51. On what amateur frequencies is frequency modulation of the emitted carrier permissible?

In the band 29,250-30,000 kc. and on all amateur frequencies above 58,500 kc. [Amateur regulations, Sec. 12.117]

52. Draw a schematic diagram of a simple device for checking carrier shift of a radiotelephone transmitter.



### Extracts from the Communications Law

The complete text of the Communications Act of 1934 would occupy many pages. Only those parts most applicable to amateur radio station licensing and regulation in this country (with which every amateur should be familiar) are given. Note particularly Secs. 324, 325, 326 and 605 and the penalties provided in Secs. 501 and 502.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,*

SECTION 1. For the purpose of regulating interstate and foreign commerce in communication by wire and radio so as to make available, so far as possible, to all the people of the United States a rapid, efficient, nation-wide, and worldwide wire and radio communication service with adequate facilities at reasonable charges, for the purpose of the national defense, for the purpose of promoting safety of life and property through the use of wire and radio communication, and for the purpose of securing a more effective execution of this policy by centralizing authority heretofore granted by law to several agencies and by granting additional authority with respect to interstate and foreign commerce in wire and radio communication, there is hereby created a commission to be known as the "Federal Communications Commission," which shall be constituted as hereinafter provided, and which shall execute and enforce the provisions of this Act.

SEC. 2. (a) The provisions of this Act shall apply to all interstate and foreign communication by wire or radio and all interstate and foreign transmission of energy by radio, which originates and/or is received within the United States, and to all persons engaged within the United States in such communication or such transmission of energy by radio, and to the licensing and regulating of all radio stations as hereinafter provided; but it shall not apply to persons engaged in wire or radio communication or transmission in the Philippine Islands or the Canal Zone, or to wire or radio communication or transmission wholly within the Philippine Islands or the Canal Zone.

SEC. 4. (a) The Federal Communications Commission (in this Act referred to as the "Commission") shall be composed of seven commissioners appointed by the President, by and with the advice and consent of the Senate, one of whom the President shall designate as chairman.

SECTION 301. It is the purpose of this Act, among other things, to maintain the control of the United States over all the channels of interstate and foreign radio transmission; and to provide for the use of such channels, but not the ownership thereof, by persons for limited periods of time, under licenses granted by Federal authority, and no such license shall be construed to create any right, beyond the terms, conditions, and periods of the license. No person shall use or operate any apparatus for the transmission of energy or communications or signals by radio (a) from one place in any Territory or possession of the United States or in the District of Columbia to another place in the same Territory, possession, or District; or (b) from any State, Territory, or possession of the United States, or from the District of Columbia to any other State, Territory, or possession of the United States; or (c) from any place in any State, Territory, or possession of the United States, or in the District of Columbia, to any place in any foreign country or to any vessel; or (d) within any State when the effects of such use extend beyond the borders of said State, or when interference is caused by such use or operation with the transmission of such energy, communications, or signals from within said State to any place beyond its borders, or from any place beyond its borders to any place within said State, or with the transmission or reception of such energy, communications, or signals from and/or to places beyond the borders of said State; or (e) upon any vessel or aircraft within the jurisdiction of the United States, except under and in accordance with this Act and with a license in that behalf granted under the provisions of this Act.

SEC. 303. Except as otherwise provided in this Act, the Commission from time to time, as public convenience, interest, or necessity requires, shall—

(a) Classify radio stations;  
(b) Prescribe the nature of the service to be rendered by each class of licensed stations and each station within any class;

(c) Assign bands of frequencies to the various classes of stations, and assign frequencies for each individual station and determine the power which each station shall use and the time during which it may operate;

(d) Determine the location of classes of stations or individual stations;

(e) Regulate the kind of apparatus to be used with respect to its external effects and the purity and sharpness of the emissions from each station and from the apparatus therein;

(f) Make such regulations not inconsistent with law as it may deem necessary to prevent interference between stations and to carry out the provisions of this Act; *Provided, however,* That changes in the frequencies, authorized power, or in the times of operation of any station, shall not be made without the consent of the station licensee unless, after a public hearing, the Commission shall determine that such changes will promote public convenience or interest or will serve public necessity, or the provisions of this Act will be more fully complied with;

(g) Study new uses for radio, provide for experimental uses of frequencies, and generally encourage the larger and more effective use of radio in the public interest; . . .

(j) Have authority to make general rules and regulations requiring stations to keep such records of programs, transmissions of energy, communications, or signals as it may deem desirable; . . .

(l) Have authority to prescribe the qualifications of station operators, to classify them according to the duties to be performed, to fix the forms of such licenses, and to issue them to such citizens of the United States as the Commission finds qualified;

(m) (1) Have authority to suspend the license of any operator upon proof sufficient to satisfy the Commission that the licensee— (A) has violated any provision of any Act, treaty, or convention binding on the United States, which the Commission is authorized to administer, or any regulation made by the Commission under any such Act, treaty, or convention; or (B) has failed to carry out a lawful order of the master or person lawfully in charge of the ships or aircraft on which he is employed; or (C) has willfully damaged or permitted radio apparatus or installations to be damaged; or (D) has transmitted superfluous radio communications or signals or communications containing profane or obscene words, language, or meaning, or has knowingly transmitted—

(1) false or deceptive signals or communications; or  
(2) a call sign or letter which has not been assigned by proper authority to the station he is operating; or

(E) has willfully or maliciously interfered with any other radio communications or signals; or (F) has obtained or attempted to obtain, or has assisted another to obtain or attempt to obtain, an operator's license by fraudulent means.

(2) No order of suspension of any operator's license shall

take effect until fifteen days' notice in writing thereof, stating the cause for the proposed suspension, has been given to the operator licensee who may make written application to the Commission at any time within said fifteen days for a hearing upon such order. The notice to the operator licensee shall not be effective until actually received by him and from that time he shall have fifteen days in which to mail the said application. In the event that physical conditions prevent mailing of the application at the expiration of the fifteen-day period, the application shall be mailed as soon as possible thereafter accompanied by a satisfactory explanation of the delay. Upon receipt by the Commission of such application for hearing, said order of suspension shall be held in abeyance until the conclusion of the hearing which shall be conducted under such rules as the Commission may prescribe. Upon the conclusion of said hearing the Commission may affirm, modify, or revoke said order of suspension.

(h) Have authority to inspect all radio installations associated with stations required to be licensed by any Act or which are subject to the provisions of any Act, treaty, or convention binding on the United States, to ascertain whether in construction, installation, and operation they conform to the requirements of the rules and regulations of the Commission, the provisions of any Act, the terms of any treaty or convention binding on the United States, and the conditions of the license or other instrument of authorization under which they are constructed, installed, or operated.

(i) Have authority to designate call letters of all stations; (j) Have authority to cause to be published such call letters and such other announcements and data as in the judgment of the Commission may be required for the efficient operation of radio stations subject to the jurisdiction of the United States and for the proper enforcement of this Act; . . .

(k) Have authority to require the painting and/or illumination of radio towers if and when in its judgment such towers constitute, or there is a reasonable possibility that they may constitute, a menace to air navigation.

(l) Make such rules and regulations and prescribe such restrictions and conditions, not inconsistent with law, as may be necessary to carry out the provisions of this Act, or any international radio or wire communications treaty or convention, or regulations annexed thereto, including any treaty or convention insofar as it relates to the use of radio, to which the United States is or may hereafter become a party.

Sec. 309. (a) If upon examination of any application for a station license or for the renewal or modification of a station license the Commission shall determine that public interest, convenience, or necessity would be served by the granting thereof, it shall authorize the issuance, renewal, or modification thereof in accordance with said finding. In the event the Commission upon examination of any such application does not reach such decision with respect thereto, it shall notify the applicant thereof, shall fix and give notice of a time and place for hearing thereon, and shall afford such applicant an opportunity to be heard under such rules and regulations as it may prescribe.

Sec. 318. The actual operation of all transmitting apparatus in any radio station for which a station license is required by this Act shall be carried on only by a person holding an operator's license issued hereunder. No person shall operate any such apparatus in such station except under and in accordance with an operator's license issued to him by the Commission.

Sec. 321. . . . (b) All radio stations, including Government stations and stations on board foreign vessels when within the territorial waters of the United States, shall give absolute priority to radio communications or signals relating to ships in distress; shall cease all sending on frequencies which will interfere with hearing a radio communication or signal of distress, and, except when engaged in answering or aiding the ship in distress, shall refrain from sending any radio communications or signals until there is assurance that no interference will be caused with the radio communications or signals relating thereto, and shall assist the vessel in distress, so far as possible, by complying with its instructions.

Sec. 324. In all circumstances, except in case of radio communications or signals relating to vessels in distress, all radio stations, including those operated by the United States, shall use the minimum amount of power necessary to carry out the communication desired.

Sec. 325. (a) No person within the jurisdiction of the United States shall knowingly utter or transmit, or cause to be uttered or transmitted, any false or fraudulent signal of distress, or communication relating thereto, nor shall any broadcasting station or station in the program or any part thereof of another broadcasting station without the express authority of the originating station.

Sec. 326. Nothing in this Act shall be understood or construed to give the Commission the power of censorship over the radio communications or signals transmitted by any radio station, and no regulation or condition shall be promulgated or fixed by the Commission which shall interfere with the right of free speech by means of radio communication. No person within the jurisdiction of the United States shall utter any obscene, indecent, or profane language by means of radio communication.

Sec. 501. Any person who willfully and knowingly does or causes or suffers to be done any act, matter, or thing, in this Act prohibited or declared to be unlawful, or who willfully and knowingly omits or fails to do any act, matter, or thing in this Act required to be done, or willfully and knowingly causes or suffers such omission or failure, shall, upon conviction thereof, be punished for such offense, for which no penalty (other than a forfeiture) is provided herein, by a fine of not more than \$10,000 or by imprisonment for a term of not more than two years, or both.

Sec. 502. Any person who willfully and knowingly violates any rule, regulation, restriction, or condition made or imposed by the Commission under authority of this Act, or any rule, regulation, restriction, or condition made or imposed by any international radio or wire communications treaty or convention, or regulations annexed thereto, to which the United States is or may hereafter become a party, shall, in addition to any other penalties provided by law, be punished, upon conviction thereof, by a fine of not more than \$500 for each and every day during which such offense occurs.

Sec. 605. No person receiving or assisting in receiving, or transmitting, or assisting in transmitting, any interstate or foreign communication by wire or radio shall divulge or publish its existence, contents, substance, purport, effect, or meaning thereof, except through authorized channels of transmission or reception, to any person other than the addressee, his agent, or attorney, or to a person employed or authorized to forward such communication to its destination, or to proper accounting or distributing officers of the various communicating centers over which the communication may be passed, or to the master of a ship under whom he is serving, or in response to a subpoena issued by a court of competent jurisdiction, or on demand of other lawful authority; and no person not being authorized by the sender shall intercept any communication and divulge or publish its existence, contents, substance, purport, effect, or meaning of such intercepted communication to any person; and no person not being entitled thereto shall receive or assist in receiving any interstate or foreign communication by wire or radio and use the same or any information therein contained for his own benefit or for the benefit of another not entitled thereto; and no person having received such intercepted communication or having become acquainted with the contents, substance, purport, effect, or meaning of the same or any part thereof, knowing that such information was so obtained, shall divulge or publish the existence, contents, substance, purport, effect, or meaning of the same or any part thereof, or use the same or any information therein contained for his own benefit or for the benefit of another not entitled thereto: *Provided*, That this section shall not apply to the receiving, divulging, publishing, or utilizing of the contents of any radio communication broadcast, or transmitted by amateurs or others for the use of the general public, or relating to ships in distress.

Sec. 606. . . . (c) Upon proclamation by the President that there exists war or a threat of war or a state of public peril or disaster or other national emergency, or in order to preserve the neutrality of the United States, the President may suspend or amend, for such time as he may see fit, the rules and regulations applicable to any or all stations within the jurisdiction of the United States as prescribed by the Commission, and may cause the closing of any station for radio communication and the removal therefrom of its apparatus and equipment, or he may authorize the use or control of any such station and/or its apparatus and equipment by any department of the Government under such regulations as he may prescribe, upon just compensation to the owners.

## United States Amateur Regulations

Pursuant to the basic communications law, general regulations for amateurs have been drafted by the Federal Communications Commission. The number before each regulation is its official number as issued by the Commission; the number is of no consequence to the amateur, except as a means of reference.



Every amateur should be *thoroughly familiar* with these regulations and their effect, although, of course, it is not necessary to know the exact wording from memory.

Particular attention should be given to the "Temporary FCC Orders" at the end of this listing, since they modify some of the regulations at the present time.

## GENERAL REGULATIONS APPLICABLE TO AMATEURS

1.71. *Applications made on prescribed forms.* Each application for an instrument of authorization shall comply with the Commission's Rules and Regulations and shall be made in writing . . . on a form furnished by . . . the Commission. . . . Separate application shall be filed for each instrument of authorization requested. . . . The required forms may be obtained from the Commission or from any of its field offices. (For a list of such offices and related geographical districts see the table following these regulations.)

1.351. *Place of filing; number of copies.* Each application for . . . station license . . . with respect to the number of copies and place of filing, shall be submitted as follows: . . . Amateur: 1 copy to be sent as follows: (a) To proper district office if it requires personal appearance for operator examination under direct supervision from that office; (b) direct to Washington, D. C., in all other cases, including examinations for Class C privileges.

1.359. *Modification of license.* . . . each application for modification of license shall be filed at least 60 days prior to the contemplated modification of license. *Provided, however,* That in emergencies and for good cause shown, the requirements hereof may be waived insofar as time for filing is concerned.

1.360. *Renewal of license.* Unless otherwise directed by the Commission, each application for renewal of license shall be filed at least 60 days prior to the expiration date of the license sought to be renewed.

1.391. *Answers to notices of violation.* Any licensee receiving official notice of a violation of the terms of the Communications Act of 1934, any legislative act, Executive order, treaty to which the United States is a party, or the Rules and Regulations of the Federal Communications Commission, shall within 3 days from such receipt, send a written answer direct to the Federal Communications Commission at Washington, D. C., and a copy thereof to the office of the Commission originating the official notice when the originating office is other than the office of the Commission in Washington, D. C.: *Provided, however,* That if an answer cannot be sent nor an acknowledgment made within such 3-day period by reason of illness or other unavoidable circumstances, acknowledgment and answer shall be made at the earliest practicable date with a satisfactory explanation of the delay. The answer to each notice shall be complete in itself and shall not be abbreviated by reference to other communications or answers to other notices. If the notice relates to some violation that may be due to the physical or electrical characteristics of transmitting apparatus, the answer shall state fully what steps, if any, are taken to prevent future violations, and if any new apparatus is to be installed, the date such apparatus was ordered, the name of the manufacturer, and promised date of delivery. . . . If the notice of violation relates to some lack of attention or improper operation of the transmitter, the name and license number of the operator in charge shall be given.

1.401. *Revocation of station license.* Whenever the Commission shall institute a revocation proceeding against the holder of any radio station . . . license . . . It shall initiate said proceeding by serving upon said licensee an order of revocation effective not less than 15 days after written notice thereof is given the licensee. The order of revocation shall contain a statement of the grounds and reasons for such proposed revocation, and a notice of the licensee's right to be heard by filing with the Commission a written request for hearing within 15 days after receipt of said order. Upon the filing of such written request for hearing by said licensee the order of revocation shall stand suspended and the Commission will set a time and place for hearing and shall give the licensee and other interested parties notice thereof. If no request for hearing on any order of revocation is made by the licensee against whom such an order is directed within the time hereinabove set forth, the order of revocation shall become final and effective without further action of the Commission. When any order of revocation has become

final, the person whose license has been revoked shall forthwith deliver the station license in question to the inspector in charge of the district in which the licensee resides.

1.411. *Suspension of operator licenses; Order of suspension.* No order of suspension of any operator's license shall take effect until 15 days' notice in writing thereof, stating the cause for the proposed suspension, has been given to the operator licensee who may make written application to the Commission at any time within said 15 days for a hearing upon such order. The notice to the operator licensee shall not be effective until actually received by him, and from that time he shall have 15 days in which to mail the said application. In the event that physical conditions prevent mailing of the application at the expiration of the 15-day period, the application shall then be mailed as soon as possible thereafter, accompanied by a satisfactory explanation of the delay. Upon receipt by the Commission of such application for a hearing, said order of suspension shall be held in abeyance until the conclusion of the hearing which shall be conducted under such rules as the Commission shall deem appropriate. Upon the conclusion of said hearing the Commission may affirm, modify, or revoke said order of suspension.

1.412. *Suspension of operator licenses; Proceedings.* Proceedings for the suspension of an operator's license shall in all cases be initiated by the entry of an order of suspension. Respondent will be given notice thereof together with notice of his right to be heard and to contest the proceeding. The effective date of the suspension will not be specified in the original order but will be fixed by subsequent motion of the Commission in accordance with the conditions specified above. Notice of the effective date of suspension will be given respondent, who shall send his operator license to the office of the Commission in Washington, D. C., on or before the said effective date, or, if the effective date has passed at the time notice is received, the license shall be sent to the Commission forthwith.

2.45. *License expiration time and periods.* Each station license will be issued so as to expire at the hour 3 A.M. eastern standard time. The normal license periods and expiration dates are specified under the rules governing the class of station concerned. (*See Sec. 12.84 of amateur regulations for amateur station-license period.*)

2.48. *Station inspection.* The licensee of any radio station shall make the station available for inspection by representatives of the Commission at any reasonable hour and under the regulations governing the class of station concerned.

2.53. *Operators, place of duty.* (a) Except as may be provided in the rules governing a particular class of station, one or more licensed operators of the grade specified by these rules and regulations shall be on duty at the place where the transmitting apparatus of such station is located and in actual charge thereof whenever it is being operated; *Provided, however,* That: (1) Subject to the provisions of paragraph (b) of this section, in the case of a station licensed for service other than broadcast, where remote control is used, the Commission may modify the foregoing requirements upon proper application and showing being made so that such operator or operators may be on duty at the control station in lieu of the place where the transmitting apparatus is located. . . .

(b) Authority to employ an operator at the control point in accordance with paragraph (a) (1) of this section shall be subject to the following conditions:

(1) The transmitter shall be so installed and protected that it is not accessible to other than duly authorized persons.

(2) The emissions of the transmitter shall be continuously monitored at the control point by a licensed operator of the grade specified for the class of station involved.

(3) Provision shall be made so that the transmitter can be quickly and without delay be placed in an inoperative condition in the event there is a deviation from the terms of the station license.

(4) The radiation of the transmitter shall be suspended immediately when there is a deviation from the terms of the station license.

2.59. *Distress messages.* Each station licensee shall give absolute priority to radio communications or signals relating to ships or aircraft in distress; shall cease all sending on frequencies which will interfere with hearing a radio communication or signal of distress. . . .

2.91. *Military or naval test communications.* The licensee of any radio station may, if proper notice from authorized government representatives is filed with and approved by the Commission, utilize such stations for military or naval test communications (messages not necessary for the conduct of ordinary governmental business) in preparation for national defense during the period or periods stated in said notice subject to the sole condition that no interference to

any service of another country will result therefrom. Nothing herein or in any other regulation of the Commission shall be construed to require any such station to participate in any such test.

## AMATEUR REGULATIONS

### DEFINITIONS

12.1. *Amateur service.* The term "amateur service" means a radio service carried on by amateur stations.

12.2. *Amateur station.* The term "amateur station" means a station used by an "amateur," that is, a duly authorized person interested in radio technique solely with a personal aim and without pecuniary interest. It embraces all radio transmitting apparatus at a particular location used for amateur service and operated under a single instrument of authorization.

12.3. *Amateur portable station.* The term "amateur portable station" means an amateur station that is portable in fact, that is so constructed that it may conveniently be moved about from place to place for communication, and that is in fact so moved from time to time, but which is not operated while in motion.

12.4. *Amateur portable-mobile station.* The term "amateur portable-mobile station" means an amateur station that is portable in fact, that is so constructed that it may conveniently be transferred to or from a mobile unit or from one such unit to another, and that is in fact so transferred from time to time and is ordinarily used while such mobile unit is in motion.

12.5. *Amateur radio communication.* The term "amateur radio communication" means radio communication between amateur stations solely with a personal aim and without pecuniary interest.

12.6. *Amateur operator.* The term "amateur operator" means a person holding a valid license issued by the Federal Communications Commission authorizing him to operate licensed amateur stations.

### LICENSES, PRIVILEGES

12.21. *Eligibility for license.* The following are eligible to apply for amateur operator license and privileges:

*Class A* — A United States citizen who has within five years of receipt of application held license as an amateur operator for a year or who in lieu thereof qualified under Section 12.46.

*Class B* — Any United States citizen.

*Class C* — A United States citizen whose actual residence, address, and station, are more than 125 miles air-line from the nearest point where examination is given at least quarterly for Class B; or is shown by physician's certificate to be unable to appear for examination due to protracted disability; or is shown by certificate of the commanding officer to be in a camp of the Civilian Conservation Corps or in the regular military or naval service of the United States at a military post or naval station and unable to appear for Class B examination.

12.22. *Classification of operating privileges.* Amateur operating privileges are as follows:

*Class A* — All amateur privileges.

*Class B* — Same as Class A except specially limited as in Section 12.110.

*Class C* — Same as Class B.

12.23. *Scope of operator authority.* Amateur operators' licenses are valid only for the operation of licensed amateur stations; provided, however, any person holding a valid radio operator's license of any class may operate stations in the experimental service authorized for, and operating on, frequencies above 300,000 kilocycles.

12.24. *Posting of license.* The original operator's license shall be posted in a conspicuous place in the room occupied by such operator while on duty or kept in his personal possession and available for inspection at all times while the operator is on duty, except when such license has been filed with application for modification or renewal, or has been mutilated, lost, or destroyed, and application has been made for a duplicate.

12.25. *Duplicate license.* Any licensee applying for a duplicate license to replace an original which has been lost, mutilated, or destroyed, shall submit to the Commission such mutilated license or affidavit attesting to the facts regarding the manner in which the original was lost or destroyed. If the original is later found, it or the duplicate shall be returned to the Commission.

12.26. *Renewal of amateur operator license.* An amateur operator license may be renewed upon proper application and a showing that within three months of receipt of the application by the Commission the licensee has lawfully operated an amateur station licensed by the Commission, that he has communicated by radio with at least three other such amateur stations. Failure to meet the requirements of this section will make it necessary for the applicant to again qualify by examination.

12.27. *Who may operate an amateur station.* An amateur station may be operated only by a person holding a valid amateur operator's license, and then only to the extent provided for by the class of privileges for which the operator's license is endorsed. When an amateur station uses radiotelephony (type A-3 emission) the licensee may permit any person to transmit by voice, provided a duly licensed amateur operator maintains control over the emissions by turning the carrier on and off when required and signs the station off after the transmission has been completed.

### EXAMINATIONS

12.41. *When required.* Examination is required for a new license as an amateur operator or for change of class of privileges.

12.42. *Elements of examination.* The examination for amateur operator privileges will comprise the following elements:

1. Code test — ability to send and receive, in plain language, messages in the International Morse Code at a speed of not less than thirteen words per minute, counting five characters to the word, each numeral or punctuation mark counting as two characters.

2. Amateur radio operation and apparatus, both telephone and telegraph.

3. Provisions of treaty, statute and regulations affecting amateurs.

4. Advanced amateur radiotelephony.

12.43. *Elements required for various privileges.* Examinations for Class A privileges will include all four examination elements as specified in Section 12.42.

Examinations for Classes B and C privileges will include elements 1, 2, and 3 as set forth in Section 12.42.

12.44. *Manner of conducting examination.* Examinations for Class A and Class B privileges will be conducted by an authorized Commission employee or representative at points specified by the Commission.

Examinations for Class C privileges will be given by volunteer examiner(s), whom the Commission may designate or permit the applicant to select; in the latter event the examiner giving the code test shall be a holder of an amateur license with Class A or B privileges, or have held within five years a license as a professional radiotelegraph operator or have within that time been employed as a radiotelegraph operator in the service of the United States; and the examiner for the written test, if not the same individual, shall be a person of legal age.

12.45. *Additional examination for holders of Class C privileges.* The Commission may require a licensee holding Class C privileges to appear at an examining point for a Class B examination. If such licensee fails to appear for examination when directed to do so, or fails to pass the supervisory examination, the license held will be canceled and the holder thereof will not be issued another license for the Class C privileges.

Whenever the holder of Class C amateur operator privileges changes his actual residence or station location to a point where he would not be eligible to apply for Class C privileges in the first instance, or whenever a new examining point is established in a region from which applicants were previously eligible for Class C privileges, such holders of Class C privileges shall within four months thereafter appear at an examining point and be examined for Class B privileges. The license will be canceled if such licensee fails: appear, or fails to pass the examination.

12.46. *Examination abridgment.* An applicant for Class A privileges, who holds a license with Class B privileges, will be required to pass only the added examination element, No. 4. (See Section 12.42.)

A holder of Class C privileges will not be accorded an abridged examination for either Class B or Class A privileges.

An applicant who has held a license for the class of privileges specified below, within five years prior to receipt of application, will be credited with examination elements as follows:

Class of license or privileges	Credits
Commercial extra 1st.....	Elements 1, 2 & 4
Radiotelegraph 1st, 2nd, or 3rd.....	Elements 1 & 2
Radiotelephone 1st or 2nd.....	Elements 2 & 4
Class A.....	Elements 2 & 4

No examination credit is given on account of license of Radiotelephone 3rd Class, nor for other class of license or privileges not above listed.

12.47. *Examination procedure.* Applicants shall write examinations in longhand—code tests and diagrams in ink or pencil, written tests in ink—except that applicants unable to do so because of physical disability may typewrite or dictate their examinations and, if unable to draw required diagrams, may make instead a detailed description essentially equivalent. The examiner shall certify the nature of the applicant's disability and, if the examination is dictated, the name and address of the person(s) taking and transcribing the applicant's dictation.

12.48. *Grading.* Code tests are graded as passed or failed, separately for sending and receiving tests. A code test is failed unless free of omission or other error for a continuous period of at least one minute at required speed. Failure to pass the required code test will terminate the examination. (See Sec. 12.49.)

A passing grade of 75 per cent is required separately for Class B and Class A written examinations.

12.49. *Eligibility for reexamination.* An applicant who fails examination for amateur privileges may not take another examination for such privileges within two months, except that this rule shall not apply to an examination for Class B following one for Class C.

#### LICENSES

12.51. *Eligibility for amateur station license.* License for an amateur station will be issued only to a licensed amateur operator who has made a satisfactory showing of control of proper transmitting apparatus and control of the premises upon which such apparatus is to be located; provided, however, that in the case of an amateur station of the military or Naval Reserve of the United States located in approved public quarters and established for training purposes, but not operated by the United States Government, a station license may be issued to a person in charge of such a station although not a licensed amateur operator.

12.52. *Eligibility of corporations or organizations to hold license.* An amateur station license will not be issued to a school, company, corporation, association, or other organization; nor for their use; provided, however, that in the case of a bona fide amateur radio society a station license may be issued in accordance with Section 12.61 to a licensed amateur operator as trustee for such society.

12.63. *Location of station.* An amateur radio station, and the control point thereof when remote control is authorized, shall not be located on premises controlled by an alien. Authority to operate by remote control will be granted only upon the filing of a proper application, and supported by a showing of the applicant's legal control of the control point, the means employed to control emissions, the equipment and method for monitoring, and the precautions adopted to prevent access to the premises by unauthorized persons.

12.64. *License period.* License for an amateur station will normally be for a period of three years from the date of issuance of a new, renewed, or modified license.

12.65. *Authorized operation.* An amateur station licensee authorizes the operation of all transmitting apparatus used by the licensee at the location specified in the station license and in addition the operation of portable and portable-mobile stations at other locations under the same instrument of authorization.

12.66. *Renewal of amateur station license.* An amateur station license may be renewed upon proper application and a showing that, within three months of receipt of the application by the Commission, the licensee thereof has lawfully operated such station in communication by radio with at least three other amateur stations licensed by the Commission, except that in the case of an application for renewal of station license issued for an amateur society or reserve group, the required operation may be by any licensed amateur operator. Upon failure to comply with the above requirements, a successor license will not be granted until two months after expiration of the old license.

12.67. *Posting of station license.* The original of each station license or a facsimile thereof shall be posted by the licensee in a conspicuous place in the room in which the transmitter is located or kept in the personal possession of the operator on duty, except when such license has been filed with application for modification or renewal, or has been mutilated, lost, or destroyed, and application has been made for a duplicate.

#### CALL SIGNALS

12.81. *Assignment of call letters.* Amateur station calls will be assigned in regular order and special requests will not be considered except that a call may be reassigned to the latest holder, or if not under license during the past five years to any previous holder, or to an amateur organization in memorandum to a deceased member and former holder, and particular calls may be temporarily assigned to stations connected with events of general public interest.

12.82. *Call signals for member of U.S.N.R.* In the case of

an amateur licensee whose station is licensed to a regularly commissioned or enlisted member of the United States Naval Reserve, the Commandant of the naval district in which such station is located may authorize in his discretion the use of the call-letter prefix N in lieu of the prefix W or K, assigned in the license issued by the Commission; provided that such N prefix shall be used only when operating in the frequency bands 1750-2050 kilocycles, 3500-4000 kilocycles, 55,000-60,000 kilocycles, and 400,000-401,000 kilocycles in accordance with instructions to be issued by the Navy Department.

12.83. *Transmission of call signals.* An operator of an amateur station shall transmit the call letters of the station called or being worked and the call letters assigned the station which he is operating at the beginning and end of each transmission and at least once every 10 minutes during every transmission of more than 10 minutes duration. In the case of stations conducting an exchange of several transmissions in sequence, each transmission of which is of less than 3 minutes duration, the call letters of the communicating stations need be transmitted only once every 10 minutes of operation in addition to transmitting the call letters, as above, at the beginning and at the termination of the correspondence. In addition, an operator of an amateur portable or portable-mobile radiotelegraph station shall transmit immediately after the call of the station the fraction-bar character (DN) followed by the number of the amateur call area in which the portable or portable-mobile amateur station is then operating, as for example:

Example 1. Portable or portable-mobile amateur station operating in the third amateur call area calls a fixed amateur station: WIABC WIABC WIABC DN W2DEF DN3 W2DEF DN3 W2DEF DN3 AR.

Example 2. Fixed amateur station answers the portable or portable-mobile amateur station. W2DEF W2DEF W2DEF DN WIABC WIABC WIABC K.

Example 3. Portable or portable-mobile amateur station calls a portable or portable-mobile amateur station: W3GHI W3GHI W3GHI DN W4JKL DN4 W4JKL DN4 W4JKL DN4 AR.

If telephony is used, the call sign of the station shall be followed by an announcement of the amateur call area in which the portable or portable-mobile station is operating.

12.91. *Requirements for portable and portable-mobile operation.* A licensee of an amateur station may operate portable amateur stations (Section 12.3) in accordance with the provisions of Sections 12.82, 12.83, 12.92 and 12.93. Such licensee may operate portable and portable-mobile amateur stations without regard to Section 12.92, but in compliance with Sections 12.82, 12.83 and 12.93, when such operation takes place on authorized amateur frequencies above 28,000 kilocycles.

12.92. *Special provisions for portable stations.* Advance notice in writing shall be given by the licensee to the inspector in charge of the district in which such portable station is to be operated. Such notices shall be given prior to any operation contemplated, and shall state the station call, name of licensee, the date of proposed operation, and the locations as specifically as possible. An amateur station operating under this Section shall not be operated during any period exceeding one month without giving further notice to the inspector in charge of the radio-inspection district in which the station will be operated, nor more than four consecutive periods of one month to the operation of portable or portable-mobile amateur stations on frequencies above 28,000 kilocycles. (See Section 12.91.)

12.93. *Special provision for non-portable stations.* The provisions for portable stations shall not be applied to any non-portable station except that:

(a) An amateur station that has been moved from one permanent location to another permanent location may be operated at the latter location in accordance with the provisions governing portable stations for a period not exceeding four months, but in no event beyond the expiration date of the license, provided an application for modification of license to change the permanent location has been made to the Commission in accordance with the rules and regulations.

(b) The licensee of an amateur station who changes residence temporarily and moves his fixed station equipment thereto or the licensee-trustee for an amateur radio society which changes the location of its fixed amateur station may operate from the new location provided that such new residence or location is to continue for a period of at least fifteen days and not to exceed four months and provided further that the following requirements are fulfilled:

(1) Advance notice in writing shall be given by the licensee or licensee-trustee to the Commission's office in Washington, and the Inspector in Charge of the district in which such fixed station is to be operated.



(2) A notice as above shall be required for each change in residence or location and a move to the original, former, or new location shall require additional notice before engaging in operation.

(3) A station operating under this Section shall employ the calling procedure specified in Sec. 12.83, using the fractional bar character followed by the number of the amateur call area in which the station is then operated.

## USE OF AMATEUR STATIONS

**12.101. Points of communication.** An amateur station shall communicate only with other amateur stations, except that in emergencies or for testing purposes it may be used also for communication with commercial or Government radio stations. In addition, amateur stations may communicate with any mobile radio station which is licensed by the Commission to communicate with amateur stations and with stations on expeditions which may also be authorized to communicate with amateur stations. They may also make transmissions to points equipped only with receiving apparatus for the measurement of emissions, observation of transmission phenomena, radio control of remote objects, and similar purely experimental purposes.

**12.102. No retransmission for use of station.** An amateur station shall not be used to transmit or receive messages for hire, nor for communication for material compensation, direct or indirect, paid or promised.

**12.103. Broadcasting prohibited.** An amateur station shall not be used for broadcasting any form of entertainment, nor for the simultaneous retransmission by automatic means of programs or signals emanating from any class of station other than amateur.

**12.104. Radiotelephone tests.** The transmission of music by an amateur station is forbidden. However, single audio-frequency tones may be transmitted by radiotelephony for test purposes of short duration in connection with the development of experimental radiotelephone equipment.

## ALLOCATION OF FREQUENCIES

**\* 12.111. Frequencies for exclusive use of amateur stations.** The following bands of frequencies are allocated exclusively for use by amateur stations:

1,750 to 2,050 kc.	28,000 to 30,000 kc.
3,500 to 4,000 kc.	50,000 to 60,000 kc.
7,000 to 7,300 kc.	112,000 to 116,000 kc.
14,000 to 14,400 kc.	224,000 to 230,000 kc.
	400,000 to 401,000 kc.

**12.112. Use of frequencies above 300,000 kilocycles.** The licensee of an amateur station may, subject to change upon further order, operate amateur stations, with any type of emission authorized for amateur stations, on any frequency above 300,000 kilocycles without separate licenses therefor.

**12.113. Individual frequency not specified.** Transmissions by an amateur station shall be on any frequency within the bands assigned. Sideband frequencies resulting from keying or modulating a transmitter shall be confined within the frequency band used.

**12.114. Types of emission.** All bands of frequencies allocated to the amateur service may be used without modulation (Type A-1 emission).

**\* 12.115. Additional bands for types of emission using amplitude modulation.** The following bands of frequencies are allocated for use by amateur stations using additional types of emission<sup>1</sup> as shown:

1,750 to 2,050 kc.	—	—	A-4	—
1,800 to 2,050 kc.	—	A-3	—	—
28,100 to 30,000 kc.	—	A-3	—	—
50,000 to 60,000 kc.	A-2	A-3	A-4	—
112,000 to 116,000 kc.	A-2	A-3	A-4	A-5
224,000 to 230,000 kc.	A-2	A-3	A-4	A-5
400,000 to 401,000 kc.	A-2	A-3	A-4	A-5

**12.116. Additional bands for radiotelephony.** Amateur stations may use radiotelephony with amplitude modulation (Type A-3 emission)<sup>1</sup> in the frequency bands 3000 to 4000 kc. and 14,150 to 14,250 kc. provided the station is licensed to a person who holds an amateur operator license endorsed with Class A privileges, and actually is operated by an amateur operator holding Class A privileges.

<sup>1</sup> Still in effect in territories and possessions and replaced in Continental U. S. by temporary rules bearing same numbers, shown in discussion of "Temporary Rearrangement" beginning on page 30.

**Types of emission:** Emissions are classified according to the purpose for which they are used, assuming their modulation or their possible keying to be only in amplitude, as follows:

- Type A-1 — Telegraphy on pure continuous waves.
- Type A-2 — Modulated telegraphy.
- Type A-3 — Telephony.
- Type A-4 — Facsimile.
- Type A-5 — Television.

<sup>2</sup> When using frequency modulation no simultaneous amplitude modulation is permitted.

**12.117. Frequency modulation.** The following bands of frequencies are allocated for use by amateur stations for radiotelephone frequency modulation transmission:<sup>2</sup>

29,250 to 30,000 kc.
58,500 to 60,000 kc.
112,000 to 116,000 kc.
224,000 to 230,000 kc.
400,000 to 401,000 kc.

## EQUIPMENT AND OPERATION

**12.131. Maximum power input.** The licensee of an amateur station is authorized to use a maximum power input of 1 kilowatt to the plate circuit of the final amplifier stage of an oscillator-amplifier transmitter or to the plate circuit of an oscillator transmitter. An amateur transmitter operating with a power input exceeding nine hundred watts to the plate circuit shall provide means for accurately measuring the plate power input to the vacuum tube, or tubes, supplying power to the antenna.

**12.132. Power supply to transmitter.** The licensee of an amateur station using frequencies below 60,000 kilocycles shall use adequately filtered direct-current plate power supply for the transmitting equipment to minimize frequency modulation and to prevent the emission of broad signals.

**12.133. Requirements for prevention of interference.** Spurious radiations from an amateur transmitter operating on a frequency below 60,000 kilocycles shall be reduced or eliminated in accordance with good engineering practice and shall not be of sufficient intensity to cause interference on receiving sets of modern design which are tuned outside the frequency band of emission normally required for the type of emission employed. In the case of A-3 emission, the transmitter shall not be modulated in excess of its modulation capability to the extent that interfering spurious radiations occur, and in no case shall the emitted carrier be amplitude-modulated in excess of 100 per cent. Means shall be employed to insure that the transmitter is not modulated in excess of its modulation capability. A spurious radiation is any radiation from a transmitter which is outside the frequency band of emission normal for the type of transmission employed, including any component whose frequency is an integral multiple or submultiple of the carrier frequency (harmonics and subharmonics), spurious modulation products, key clicks, and other transient effects, and parasitic oscillations. The frequency of emission shall be as constant as the state of the art permits.

**12.134. Modulation of carrier wave.** Except for brief tests or adjustments, an amateur radiotelephone station shall not emit a carrier wave on frequencies below 112,000 kilocycles unless modulated for the purpose of communication.

**12.135. Frequency measurement and regular check.** The licensee of an amateur station shall provide for measurement of the transmitter frequency and establish procedure for checking it regularly. The measurement of the transmitter frequency shall be made by means independent of the frequency control of the transmitter and shall be of sufficient accuracy to assure operation within the frequency band used.

**12.136. Logs.** Each licensee of an amateur station shall keep an accurate log of station operation, including the following data:

(a) The date and time of each transmission. (The date need only be entered once for each day's operation. The expression "time of each transmission" means the time of making a call and need not be repeated during the sequence of communication which immediately follows; however, an entry shall be made in the log when "signing off" so as to show the period during which communication was carried on.)

(b) The signature of the person manipulating the transmitting key of a radiotelegraph transmitter or the signature of the person operating a transmitter of any other type (Type A-3 or A-4 emission) with statement as to type of emission, and the signature of any other person who transmits by voice over a radiotelephone transmitter (Type A-3 emission). (The signature need only be entered once in the log provided the log contains a statement to the effect that all transmissions were made by the person named except where otherwise stated. The signature of any other person who operates the station shall be entered in the proper space for his transmissions.)

(c) Call letters of the station called. (This entry need not be repeated for calls made to the same station during any sequence of communication, provided the time of "signing off" is given.)

(d) The input power to the oscillator, or to the final amplifier stage where an oscillator-amplifier transmitter is employed. (This need be entered only once, provided the input power is not changed.)

(e) The frequency band used. (This information need be entered only once in the log for all transmissions until there is a change in frequency to another amateur band.)



(f) The location of a portable or portable-mobile station at the time of each transmission. (This need be entered only once provided the location of the station is not changed. However, suitable entry shall be made in the log upon changing location, showing the type of vehicle or mobile unit in which the station is operated and the approximate geographical location of the station at the time of operation.)

(g) The message traffic handled. (If record communications are handled in regular message form, a copy of each message sent and received shall be entered in the log or retained on file for at least one year.)

The log shall be preserved for a period of at least one year following the last date of entry. The copies of record communications and station log, as required under this section, shall be available for inspection upon request by an authorized Government representative.

#### SPECIAL CONDITIONS

12.151. *Additional conditions to be observed by licensee.* An amateur station license is granted subject to the conditions imposed in Sections 12.152 to 12.155 inclusive. In addition to any others that may be imposed during the term of the license. Any licensee receiving due notice requiring the station licensee to observe such conditions shall immediately act in conformity therewith.

12.152. *Quiet hours.* In the event that the operation of an amateur station causes general interference to the reception of broadcast programs with receivers of modern design, such amateur station shall not operate during the hours from 8 o'clock P.M. to 10:30 P.M., local time, and on Sunday for the additional period from 10:30 A.M. until 1 P.M., local time, upon such frequency or frequencies as cause such interference.

12.153. *Second notice of same violation.* In every case where an amateur station licensee is cited a second time within a year for the same violation under Sections 12.111, 12.113, 12.114, 12.116, 12.117, 12.132, or 12.133, the Commission will direct that the station remain silent from 6 P.M. to 10:30 P.M., local time, until written notice has been received authorizing full-time operation. The licensee shall arrange for tests at other hours with at least two amateur stations within fifteen days of the date of notice, such tests to be made for the specific purpose of aiding the licensee in determining whether the emissions of his station are in accordance with the Commission's Regulations. The licensee shall report under oath to the Commission at the conclusion of the tests as to the observations reported by amateur licensees in relation to the reported violation. Such reports shall include a statement as to the corrective measures taken to insure compliance with the Regulations.

12.154. *Third notice of same violation.* In every case where an amateur station licensee is cited the third time within a year for the same violation as indicated in Section 12.153, the Commission will direct that the station remain silent from 8 A.M. to 12 midnight, local time, except for the purpose of transmitting a prearranged test to be observed by a monitoring station of the Commission to be designated in each particular case. Upon completion of the test this station shall again remain silent during these hours until authorized by the Commission to resume full-time operation. The Commission will consider the results of the tests and the licensee's past record in determining the advisability of suspending the operator license and/or revoking the station license.

12.155. *Operation in emergency.* In the event of widespread emergency conditions affecting domestic communication facilities, the Commission may confer with representatives of the amateur service and others and, if deemed advisable, will declare that a state of general communications emergency exists, designating the licensing area or areas concerned (in general not exceeding 1000 miles from center of the affected area), whereupon it shall be incumbent upon each amateur station in such area or areas to observe the following restrictions for the duration of such emergency:

(a) No transmissions except those relating to relief work or other emergency service such as amateur nets can afford, shall be made within the 1750-2050 kilocycle or 3500-4000 kilocycle amateur bands. Incidental calling, testing, or working, including casual conversation or remarks not pertinent or necessary to constructive handling of the general situation shall be prohibited.

(b) The frequencies 2025-2050, 3500-3525, and 3975-4000 kilocycles shall be reserved for emergency calling channels, for initial calls from isolated stations or first calls concerning very important emergency relief matters or arrangements. All stations having occasion to use such channels shall, as quickly as possible, shift to other frequencies for carrying on their communications.

(c) A five-minute listening period for the first five minutes of each hour shall be observed for initial calls of major importance, both in the designated emergency calling

channels and throughout the 1750-2050 and 3500-4000 kilocycle bands. Only stations isolated or engaged in handling official traffic of the highest priority may continue with transmissions in these listening periods, which must be accurately observed. No replies to calls or resumption of routine traffic shall be made in the five-minute listening period.

(d) The Commission may designate certain amateur stations to assist in promulgation of its emergency and disaster official traffic of the highest priority may continue with transmissions in these listening periods, which must be accurately observed. No replies to calls or resumption of routine traffic shall be made in the five-minute listening period.

(e) These special conditions imposed under this Section will cease to apply only after the Commission shall have declared such emergency to be terminated.

12.156. *Obscenity, indecency, profanity.* No licensed radio operator or other person shall transmit communications containing obscene, indecent, or profane words, language, or meaning.

12.157. *False signals.* No licensed radio operator shall transmit false or deceptive signals or communications by radio, or any call letter or signal which has not been assigned by proper authority to the radio station he is operating.

12.158. *Unidentified communications.* No licensed radio operator shall transmit unidentified radio communications or signals.

12.159. *Interference.* No licensed radio operator shall willfully or maliciously interfere with or cause interference to any radio communication or signal.

12.160. *Damage to apparatus.* No licensed radio operator shall willfully damage or permit to be damaged, any radio apparatus or installation in any licensed radio station.

12.161. *Fraudulent licenses.* No licensed radio operator or other person shall obtain or attempt to obtain, or assist another to obtain or attempt to obtain, an operator license by fraudulent means.

#### TEMPORARY F.C.C. ORDERS

##### ORDER NO. 72

At a meeting of the Federal Communications Commission held at its offices in Washington, D. C., on the fourth day of June, 1940:

Pursuant to authority contained in Sec. 303 of the Communications Act of 1934, and in accordance with Article 8, Sec. 1, General Radio Regulations (Chiro Revision, 1938) annexed to the International Telecommunications Convention (Madrid, 1934).

IT IS ORDERED, That amateur radio operators and amateur radio stations licensed by the Federal Communications Commission shall not exchange communications with operators or radio stations of any foreign government or located in any foreign country; Provided, however, that this Order is not intended to prohibit the exchange of communications between licensed amateur operators and licensed amateur stations in the continental United States and licensed amateur operators and licensed amateur stations in the several Territories and possessions of the United States, or between licensed amateur operators and licensed amateur stations in the continental United States and United States citizens authorized to operate amateur stations in the Philippine Islands or the Canal Zone, or between licensed amateur operators and licensed amateur stations in the several Territories and possessions of the United States.

IT IS FURTHER ORDERED, That all Rules and Regulations of the Commission inconsistent with this Order, BE, AND THE SAME ARE HEREBY, SUSPENDED, pending the further Order of the Commission.

This Order shall become effective immediately.

##### ORDER NO. 73

At a meeting of the Federal Communications Commission held at its offices in Washington, D. C., on the seventh day of June, 1940.

Pursuant to authority contained in Section 303 of the Communications Act of 1934, as amended,

IT IS ORDERED, That portable and portable-mobile radio station operation by licensed amateur operators and stations BE, AND THE SAME IS HEREBY, PROHIBITED, pending the further Order of the Commission; Provided that licensed portable and portable-mobile amateur stations may operate on frequencies above 50,000 kilocycles at locations within the continental United States, its Territories and possessions, and Provided further that during the period of the American Radio Relay League field day tests, June 22-23, 1940, this Order shall not apply to communications transmitted by licensed portable and portable-mobile amateur stations participating in such tests.

IT IS FURTHER ORDERED, That all Rules and Regulations of the Commission inconsistent with this Order BE, AND THE SAME ARE HEREBY, SUSPENDED, pending the further Order of the Commission.

This Order shall become effective immediately.

## ORDER NO. 73-A

At a meeting of the Federal Communications Commission held at its offices in Washington, D. C., on the 11th day of June, 1940:

IT IS ORDERED, That Commission Order No. 73 dated on the seventh day of June, 1940, BE, AND THE SAME IS HEREBY, AMENDED by adding to the first ordering paragraph thereof the following: "It is further provided that this order shall not apply to the operation of licensed portable and portable-mobile amateur stations (1) actually engaged in supplying or attempting to supply domestic communication in the public interest during a bona fide communications emergency when normal facilities are inadequate or non-existent, or (2) actually engaged in the domestic testing and developing of self-powered portable and portable-mobile equipment intended for use in domestic communications emergencies, during the hours between sunrise and sunset, local time, on Saturdays and Sundays of each week, provided notice of such testing and developing operation shall have been given at least 48 hours in advance to the Federal Communications Commission Inspector in Charge of the district in which such operation is contemplated.

This order shall become effective immediately.

## ORDER NO. 75<sup>1</sup>

(Effective until further order of the FCC)

At a meeting of the Federal Communications Commission held at its offices in Washington, D. C., on the 18th day of June, 1940.

Pursuant to authority contained in the Communications Act of 1934, as amended,

IT IS ORDERED, That on or before the 15th day of August 1940, each radio operator who holds an outstanding commercial or amateur radio operator license issued by this Commission, shall file with the Commission his response, under oath, to the attached questionnaire (Form No. 735) and shall furnish the additional data and documents required therein;

IT IS FURTHER ORDERED, That on and after the date of this Order, each application for a new commercial or amateur radio operator license shall be accompanied by the applicant's response, under oath, to the attached questionnaire (Form No. 735) together with the additional data and documents required therein;

IT IS FURTHER ORDERED, That on and after the date of this Order, each application for a renewal of a commercial or amateur radio operator license shall be accompanied by the applicant's response to the attached questionnaire (Form No. 735), together with the additional data and documents required therein; Provided, however, that such response need not be submitted with a renewal application if a response previously has been made pursuant to the first ordering paragraph herein.

This Order shall become effective immediately.

## ORDER NO. 77-D

(Effective until January 1, 1946)

At a session of the Federal Communications Commission held at its offices in Washington, D. C., on the 27th day of December, 1944.

The Commission having under consideration its Rules Governing Amateur Radio Stations and Operators and its Rules Governing Commercial Radio Operators, with particular reference to the provisions concerning renewals; and

<sup>1</sup>This order refers to the requirement for proof of U. S. citizenship and fingerprinting of all radio operator licensees and applicants; see treatment in text, page 6.

IT APPEARING, that present conditions render it difficult for commercial radio operators and for amateur radio station licensees and operators to make the showing of service or use required for renewal of license; and that such difficulty will be accentuated in many instances due to military service;

IT IS ORDERED, that Sections 12.20 and 12.66 of the Rules Governing Amateur Radio Stations and Operators and Section 13.28 of the Rules Governing Commercial Radio Operators, in so far as the required showing of service or use of license is concerned, BE, AND THEY ARE HEREBY, SUSPENDED until further order of the Commission, but in no event beyond January 1, 1946.

This Order shall become effective January 1, 1945.

## ORDER NO. 101

At a session of the Federal Communications Commission held at its offices at Washington, D. C., on the 19th of June, 1942,

Pursuant to the authority conferred upon it by Order No. 4, dated April 10, 1942, of the Defense Communications Board; IT IS ORDERED, That

- (a) every holder of an amateur radio station license in possession of a radio transmitter and
- (b) every other person or organization in possession of a radio transmitter which is owned by a holder of an amateur radio station license

apply for registration of such transmitter with the Commission (if such transmitter is not registered under FCC Order No. 99) in accordance with the following provisions:

(1) "Radio transmitter" as herein used means a device designed for transmission of communications by radio frequency energy. This Order is not intended to include phonograph oscillators, test oscillators, signal generators and wired radio systems.

(2) Every person now in possession of a transmitter required to be registered under this Order shall apply for such registration not later than August 25, 1942. Every person who, at any time after the date of this Order, comes into possession of a transmitter which is required to be registered hereunder shall apply to the Commission for a Certificate of Registration within 15 days after obtaining such possession or by August 25, whichever is the later date.

(3) Application for registration shall be made on forms furnished by the Commission and such forms shall be obtained from the Federal Communications Commission in Washington, D. C., or from any of its field offices.

(4) Individual application must be made for each transmitter to be registered and each transmitter must be separately registered. All requests for application forms should state the number of transmitters to be registered.

(5) All application forms should be returned to the Secretary, Federal Communications Commission, Washington, D. C. (not to any field office).

(6) If, upon receipt of an application for registration, the Commission finds that sufficient and reliable information has been furnished, it will issue to the applicant a non-transferable certificate of registration for each transmitter.

(7) The registrant shall be responsible for having the certificate of registration conspicuously affixed to the transmitter for which it is issued. No certificate shall be destroyed, obliterated or altered in any way without the authority of the Commission.

(8) If a transmitter for which a certificate of registration has been issued is transferred, sold, assigned, leased, loaned, stolen, dismantled, destroyed or in any way removed from the possession of the registrant (holder of a certificate of registration), he shall notify the Commission thereof within five days thereafter, furnishing a statement as to such loss, disposal or disappearance and furnishing the name of the recipient of the transmitter if such person is known to the registrant. In such case it shall be the duty of the registrant to return the certificate of registration to the Commission unless it has been stolen or destroyed.

(9) The registrant shall notify the Commission, within five days, or by August 25, 1942, whichever is the later date, whenever the transmitter registered is moved from its registered location to another location.

(10) Any transmitter required to be registered under this Order and for which there is no valid registration certificate outstanding shall be subject to closure and removal by the Commission.

(11) The following transmitters shall not be subject to the registration provisions of this Order:

Transmitters, the operation of which is authorized under a Commission station license other than an amateur radio station license. Transmitters in the possession of the United States Government, its officers or agents, or which are under contract for delivery to the United States.

IT IS FURTHER ORDERED, That every holder of an amateur radio station license who neither owns nor has an amateur radio transmitter in his possession shall

so report to the Commission, in writing, and shall notify the Commission of his present address not later than August 25, 1942; and further, he shall notify the Commission, in writing, within five days of any change of address.

#### ORDER NO. 115

At a session of the Federal Communications Commission held at its offices in Washington, D.C., on the 25th day of May, 1943:

WHEREAS, present conditions render it difficult for amateur radio operators who are in the military service of the United States or engaged in war work at locations distant from their homes to ascertain the expiration dates of their amateur radio operator licenses and to make timely and proper application for their renewal; and

WHEREAS, no person is presently authorized to engage in any amateur radio station operation in the continental United States, its territories and possessions under the provisions of Commission Orders 87 and 87-A adopted December 8, 1941, and January 8, 1942, respectively; and

WHEREAS, the Commission has, under Order 87-B adopted September 15, 1942, discontinued the issuance of renewed or modified amateur radio station licenses but has continued, at the request of the military, to issue new or renewed operator licenses;

#### IT IS ORDERED THAT:

1. Every amateur radio operator license which by its terms expired during the period December 7, 1941, to May 25, 1943, inclusive, and has not been renewed, BE, AND THE SAME IS HEREBY REINSTATED, and the license term thereof IS HEREBY EXTENDED for a period of three years from the date of expiration provided therein.

2. The license term of every amateur radio operator license which by its terms expires during the period May 26, 1943, to December 7, 1944, inclusive, BE, AND THE SAME IS HEREBY EXTENDED, for a period of three years from the date of expiration provided therein.

PROVIDED HOWEVER, That the provisions of this Order shall not apply to any amateur radio operator license which has been, or may hereafter be, finally suspended by Commission Order, or has been voluntarily surrendered by the licensee, or to any amateur radio operator licenses who has failed to comply with Commission Order No. 75, as amended.

3. The provisions of Section 12.26 of the Rules and Regulations to the extent that they are inconsistent with the provisions of this Order are hereby suspended until further order of the Commission.

#### ORDER NO. 115-A

At a session of the Federal Communications Commission held at its offices in Washington, D.C., on the 28th day of November, 1944: WHEREAS, . . . IT IS ORDERED, That:

1. Every amateur radio operator license which by its terms expired during the period December 7, 1941, to December 7, 1942, inclusive, but the duration of which has been extended by Commission Order No. 115 for a period of three years from the date of expiration provided therein, is extended for a period of one year from the date of expiration as extended by Order 115.

2. Every amateur radio operator license issued during the period December 7, 1941, to December 7, 1942, inclusive, is hereby extended for a period of one year from the date of expiration provided therein.

Provided, however, . . . (Rest of order same as Order 115.)

#### Temporary Rearrangement of Frequencies

There is one matter in the operator examination which is likely to offer confusion unless it is carefully studied. In the summer of 1941, before the outbreak of war, defense training needs of the Army resulted in plans for a temporary rearrangement of amateur bands so that some of the amateur frequencies could be used for military purposes. It was planned to transfer the frequencies 3650-3950 kc. as a temporary loan for this purpose, and to do it gradually, in three installments beginning in the winter of 1941. There

were also to be, simultaneously, some changes in amateur 'phone assignments which would help readjustment. The first of these orders was issued by FCC on August 22, 1941, to become effective December 20, 1941, and two more orders were expected during the winter. War broke out on December 7, 1941, and amateur stations were closed, but the first order went into effect nonetheless and changed the regulations applicable to amateurs. However, the other two orders were never issued. Thus there is a peculiar regulatory situation, with the changes only partly accomplished, never finished, not yet withdrawn. What the applicant for a license must do is to learn the situation as it is to-day and give his answers in those terms.

Effective December 20, 1941, Secs. 12.111 and 12.115 of the FCC rules were suspended within the continental limits of the United States and temporarily replaced by the following:

**Temporary Rule 12.111. Frequencies for exclusive use of amateur stations.** The following bands of frequencies are allocated exclusively for use by amateur stations, subject to change with respect to 3650-3900 kilocycles and 3900-3950 kilocycles upon further order of the Commission:

1,750 to 2,050 kc.	28,000 to 30,000 kc.
3,500 to 3,800 kc.	56,000 to 60,000 kc.
3,900 to 4,000 kc.	112,000 to 116,000 kc.
7,000 to 7,300 kc.	224,000 to 230,000 kc.
14,000 to 14,400 kc.	400,000 to 401,000 kc.

Provided, however, that amateur licenses located in the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia, Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, Wyoming, Montana, Idaho, Oregon, and Washington, may use the frequencies in the band 3800-3900 kilocycles for Type A-1 emission during the period between two hours after local sunrise and two hours before local sunset subject to the condition that no interference is caused to government operation on these frequencies. The privilege conferred by this proviso with respect to any amateur or to the amateurs within any area may be terminated at any time without advance notice or hearing should interference develop.

**Temporary Rule 12.115. Additional bands for types of emission using amplitude modulation.** The following bands of frequencies are allocated for use by amateur stations using additional types of emission as shown:

1,750 to 1,900 kc.	...	A-3	...	A-4	...
1,900 to 2,050 kc.	...	A-3	...	A-4	...
7,250 to 7,300 kc.	...	A-3	...	A-4	...
28,100 to 30,000 kc.	...	A-3	...	A-4	...
56,000 to 60,000 kc.	A-2	A-3	A-4	A-5	...
112,000 to 116,000 kc.	A-2	A-3	A-4	A-5	...
224,000 to 230,000 kc.	A-2	A-3	A-4	A-5	...
400,000 to 401,000 kc.	A-2	A-3	A-4	A-5	...

Note that, so far as continental United States is concerned, the above text for the time being replaces the original text of these rules on page 27, but that the original text still applies in the territories and possessions. That is why there is a two-way answer to Question 56 on page 16, about 'phone frequencies. Note also that in the territories and possessions the 80-meter band remains intact over the entire range 3500 to 4000 kc., but in continental U.S. it must temporarily and technically be thought of as two bands, 3500-3800 kc. and 3900-4000 kc.



## INDEX

(In the references, whole numbers such as 1, 3, 7, etc., represent page numbers in the manual; decimal numbers preceded by f indicate paragraphs of the regulations; a reference made to the Act means the quoted section will be found in the extracts from the Communications Act of 1934, preceding the regulations in the rear of the booklet.)

- Activity not required for license modification . . . . . 7
- Activity required for license renewal
  - \$12.26, \$12.05, Order 77-D
- Advance notice, portable, and other, operation
  - 2, \$12.02, \$12.93, Order 73, 73-A
- Aliens ineligible for licenses . . . . . 1, 2, \$12.21, \$12.63
- Amateur bands . . . . . \$12.111
- (See also "Temporary Rearrangement of Frequencies," page 29)
- Amateur operator, definition of . . . . . \$12.6
- Amateur radio communication, definition of . . . . . \$12.5
- Amateur radio communication restricted . . . . . 0, Order 72
- Amateur service . . . . . \$12.1
- Amateur station:
  - Definition . . . . . \$12.2
  - Who may operate . . . . . \$12.27
- Amplitude modulation, bands for . . . . . \$12.115, \$12.110, 30
- Applications for license, filing . . . . . 4, 5, \$1.351
- Application forms . . . . . 4, 5, \$1.71
- Assignment of call letters . . . . . \$12.81
- Audio frequency tones permitted for testing . . . . . \$12.104
- Bands, amateur . . . . . \$12.111
  - Temporary rearrangement of . . . . . 29
- Bands, emergency . . . . . \$12.155 (a)
- Broadcasting prohibited . . . . . \$12.103
- Broad signals, prevention of . . . . . \$12.132
- Calling channels, emergency . . . . . \$12.155 (b)
- Call letter assignment . . . . . \$12.81, \$12.82
- Call letters, entry in log . . . . . \$12.136 (c)
- Call letters, re-issuance . . . . . 9
- Call signals, transmission of . . . . . \$12.83
- Canal Zone . . . . . Act Sec. 2 (a)
- Carrier, unmodulated radiotelephone prohibited . . . . . \$12.134
- Citizenship proof required . . . . . 5, Order 75
- Civilian Conservation Corps . . . . . \$12.21
- Class A license:
  - Citizenship proof required . . . . . 5, Order 75
  - Credits and exemptions for . . . . . \$12.46
  - Eligibility for . . . . . \$12.21
  - Examination cities . . . . . 4
  - Examination elements . . . . . \$12.43
  - Examination, nature of . . . . . 8, 17
  - Examiner requirements . . . . . \$12.44
  - Operating privileges . . . . . 3, \$12.22, \$12.116
- Class B license:
  - Citizenship proof required . . . . . 5, Order 75
  - Credits and exemptions for . . . . . \$12.46
  - Eligibility for . . . . . 3, \$12.21
  - Examination cities . . . . . 4
  - Examination elements . . . . . \$12.43
  - Examination, nature of . . . . . 7
  - Examiner requirements . . . . . \$12.44
  - Operating privileges . . . . . 3, \$12.22
  - Special conditions in which required . . . . . 3, \$12.45
- Class C license:
  - Citizenship proof required . . . . . 5, Order 75
  - Additional examinations for, when required . . . . . 3, \$12.45
  - Code test for . . . . . 4, \$12.44
  - Eligibility for . . . . . 3, \$12.21
  - Examination elements . . . . . \$12.43
  - Examination, nature of . . . . . 7
  - Examiner requirements . . . . . 4, \$12.44
  - Operating privileges . . . . . 3, \$12.22
- Club licenses . . . . . \$12.62
- Code test . . . . . \$12.42, \$12.48
- Compensation prohibited . . . . . \$12.102
- Control point, remote control . . . . . \$2.53, \$12.63
- Disability, physical . . . . . 6, \$12.21, \$12.47
- Distress message priority . . . . . \$2.59
- Duplicate license, application for . . . . . \$12.25
- Eligibility:
  - For operator license . . . . . \$12.21
  - For re-examination . . . . . \$12.49
  - For station license . . . . . \$12.61, \$12.62
- Emergencies, operation in . . . . . \$12.155, Order 73-A
- Emission, types of . . . . . \$12.114 (and footnote)
- Examinations:
  - Code test . . . . . 4, \$12.42, \$12.48
  - Credits for . . . . . \$12.46
  - Grading . . . . . \$12.48
  - Eligibility for re-examination . . . . . 4, \$12.49
  - Manner of conducting . . . . . 4, 5, \$12.44
  - Nature of . . . . . 8, \$12.42, \$12.43
  - Points where given . . . . . 4, front cover
  - Procedure . . . . . 4, 5, \$12.47
  - When required . . . . . \$12.41
- Exemptions, operator license applications . . . . . 7, \$12.46
- Expeditions, communication with . . . . . \$12.101, Order 72
- Experimental uses of amateur stations . . . . . \$12.101
- Expiration time and periods, license . . . . . \$2.45, \$12.64
- Extension of operator licenses . . . . . 6, 9, Orders 115, 115-A
- Facsimile of station license authorized . . . . . \$12.67
- Federal Communications Commission:
  - Authority for . . . . . Act Sec. 1
  - Composition of . . . . . Act Sec. 4 (a)
  - Duties . . . . . Act Sec. 303
- Foreign contacts prohibited . . . . . Order 7
- Forms prescribed for applications . . . . . \$1.71
- Frequency measurement and check required . . . . . \$12.13
- Frequency modulation:
  - Bands for . . . . . \$12.117
  - Minimizing . . . . . \$12.132
- Grading, examination and code test . . . . . \$12.48
- Harmonics . . . . . \$12.133
- Hearings, right to request . . . . . \$1.401, \$1.411, \$1.412
- Input power, maximum . . . . . \$12.131
- Interference, prevention of . . . . . \$12.133
- Interstate communication . . . . . Act Sec. 2 (a)
- Jurisdiction, Communications Act . . . . . Act Sec. 2 (a)
- Key Clicks . . . . . \$12.133
- Licensing: (See also "Class A license," "Class B license," "Class C license")
  - Activity required for renewal
    - 6, \$12.26, \$12.66, Order 77-A
  - Alaska . . . . . 5
  - Aliens ineligible for . . . . . 1, 2, \$12.21, \$12.63
  - Application form required . . . . . \$1.71
  - Application, where filed . . . . . \$1.351
  - Applying for . . . . . 3, 4, 5
  - Call letter assignment . . . . . \$12.81, \$12.82
  - Canal Zone . . . . . Act Sec. 2 (a)
  - Citizenship proof required . . . . . 5, Order 75
  - Civilian Conservation Corps . . . . . \$12.21
  - Clubs . . . . . \$12.62
  - Code test . . . . . \$12.42, \$12.48
  - Duplicate license applications . . . . . \$12.25
  - Eligibility for operator and station licenses
    - 1, 2, \$12.21, \$12.61, \$12.62
- Examinations (see "Examinations")
  - Expiration time . . . . . \$2.45
  - Facsimile of station license authorized . . . . . 2, \$12.67
  - Guam . . . . . 5
  - Location of station restricted . . . . . 2, \$12.63
  - Military and naval posts . . . . . \$12.21, \$12.61
  - Modifications . . . . . \$1.359
  - Philippine Islands . . . . . Act Sec. 2 (a)
  - Physical disability . . . . . 6, \$12.21, \$12.47
  - Posting of license . . . . . 2, \$12.24, \$12.67



Renewals.....6, 9, §1.360, §12.28, §12.66, Order 77-D	
Re-examinations.....4, §12.49	
Requirement for.....1	
Revocations.....§1.401	
Special conditions for physically disabled.....	
§12.21, §12.47	
Suspensions.....§1.411, §1.412	
Term.....§12.64	
Listening period, emergency.....§12.155 (c)	
Location of station restricted.....1, 2, §12.63	
Logs.....§12.136	
Messages, file to be kept.....§12.136 (g)	
Message traffic, entry in log.....§12.136 (g)	
Military and naval posts, licenses for.....§12.21, §12.61	
Modification of license.....6, §1.359	
Modulation:	
Amplitude, bands for.....§12.115, §12.116, 30	
Frequency bands for.....§12.117	
Maximum percentage permitted.....§12.133	
Of radiotelephone carrier required.....§12.134	
Music transmission forbidden.....§12.104	
Naval Reserve call letter prefix.....§12.82	
N prefixes.....§12.82	
Notices of violation.....§1.391, §12.153, §12.154	
Observing stations, emergency.....§12.155 (d)	
One-way transmissions.....§12.101	
Operating privileges.....§12.22	
Operation of fixed station at temporary location.....§12.93 (b)	
Operation while renewal pending.....6, §12.24, §12.67	
Operator:	
Amateur.....§12.6	
Place of duty.....§2.53	
Operator authority, scope of.....§12.23, §12.27	
Operator license: (see also "Class A license," "Class B license," "Class C license")	
Application forms.....§1.71	
Application, filing.....§1.351	
Citizenship proof required.....5, Order 75	
Posting.....§12.24	
Requirement for.....1	
Suspension of.....§1.411, §1.412	
Philippines.....Act Sec. 2 (a)	
Physical disability.....6, §12.21	
Policing authority, emergency.....§12.155 (d)	
Points, examination.....Front cover, 4	
Portable and portable-mobile stations:	
Advance notice required.....§12.92	
Calling procedure.....§12.63	
Definitions of.....§12.3, §12.4	
Logs.....§12.136 (f)	
Operation at permanent location.....2, §12.93	
Requirements for operation.....2, §12.91	
Restrictions on.....Orders 73, 73-A	
Portable procedure, use of: (See also §12.83)	
At temporary location of fixed station.....§12.93 (b)	
While awaiting modification.....§12.93 (a)	
Posting of license.....§12.24, §12.67	
Power input, maximum.....§12.131	
Power supply requirements.....§12.132	
Priority of distress messages.....§2.59	
Procedure, examination.....§12.47	
Quiet hours.....§12.152	
Radiocommunication, amateur.....§12.5	
Restrictions on.....9, Orders 72, 73, 73-A	
Radiotelephony:	
Bands for.....§12.115, §12.116, §12.117, 30	
Carrier modulation required.....§12.134	
Modulation percentage.....§12.133	
Music prohibited.....§12.104	
Sideband Frequency limits.....§12.113	
Tests.....§12.104	
Rebroadcasting.....§12.103	
Re-examination.....4, §12.49	
Registration of transmitters.....9, Order 101	
Remote control.....3, §2.53, §12.63	
Renewal:	
Activity not required for.....Order 77-D	
Filing time.....6, §1.360	
Of operator license.....6, 9, §12.26	
Of station license.....6, 9, §12.66	
Revocation of station license.....§1.401	
Service, amateur.....§12.1	
Sideband frequency limits.....§12.113	
Signing of log.....§12.136 (b)	
Spurious radiations, prevention of.....§12.133	
Station:	
Alien control prohibited.....1, 2, §12.21, §12.63	
Amateur (definition).....§12.2	
License requirement.....1	
Location.....§12.63, §12.65, §12.93	
Portable.....§11.3, §12.65	
Portable.....§12.3, §12.65	
Portable-mobile.....§12.4, §12.65	
Use of.....§12.101, §12.102, §12.103, §12.104, 9	
Station license:	
Application forms.....§1.71	
Application, filing.....§1.351	
Class of operator license required.....2	
Facsimile of, authorized.....2, §12.67	
Modification of.....7	
Posting.....§12.67	
Requirement for.....1, 2	
Revocation of.....§1.401	
Suspension of operator license.....§1.411, §1.412	
Temporary Location (of fixed station).....§12.93 (b)	
Temporary rearrangement of frequencies.....30	
Term of license.....§12.64	
Test communications, military or naval.....§2.91	
Tones, audio, permitted for testing.....§12.104	
Transmitters:	
Frequency measurement required.....§12.135	
Power input maximum.....§12.131	
Power supply requirements.....§12.132	
Unlicensed persons, transmissions by.....§12.27, §12.136 (b)	
Unmodulated radiotelephone carrier prohibited.....§12.134	
Violations:	
Answers to notices of.....§1.391	
Second notice.....§12.153	
Third notice.....§12.154	
Wartime changes.....9, 28, 29, 30	



# hallicrafters

## ***New design, new utility in a great new communications receiver . . .***

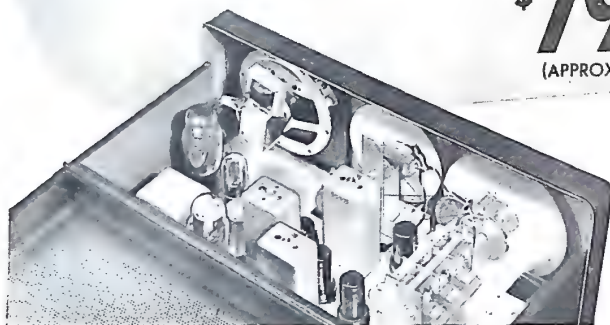
Here is Hallicrafters new Model S-40. With this great communications receiver, handsomely designed, expertly engineered, Hallicrafters points the way to exciting new developments in amateur radio. Read those specifications . . . it's tailor-made for hams. Look at the sheer beauty of the S-40 . . . nothing like it to be seen in the communications field. Listen to the amazing performance . . . excels anything in its price class. All around, up and down, through and through it's a true Hallicrafters-built ham job.

See your local distributor about when you can get an S-40—the up and coming leader in the popular price field.

**INSIDE STUFF:** Beneath the sleek exterior of the S-40 is a beautifully engineered chassis. One stage of tuned radio frequency amplification, the S-40 uses a type 6SA7 tube as converter-mixer for best signal to noise ratio. RF coils are of the permeability adjusted "micro-set" type identical with those used in the most expensive Hallicrafters receivers. The high frequency oscillator is temperature compensated for maximum stability.

*From every angle the S-40 is an ideal receiver for all high frequency applications.*

**\$79<sup>50</sup>**  
(APPROXIMATELY)



Interior completely accessible. Entire top turns back on piano hinge.

COPYRIGHT 1945  
THE HALLICRAFTERS CO.

# *new Model* S-40

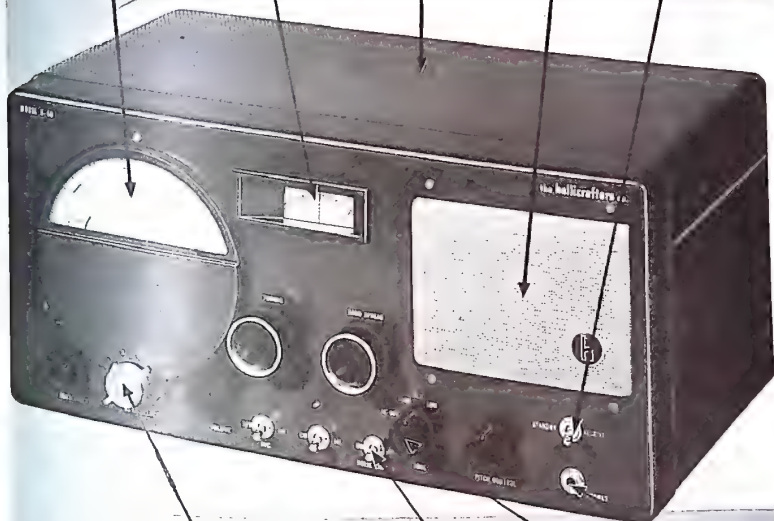
Tuning range from 540 kc to 42 Mc continuous in four bands

Separate electrical bandspread with inertia flywheel tuning

New beauty and perfect ventilation in the perforated steel top

Self-contained, shock mounted, permanent magnet dynamic speaker

Standby receive switch

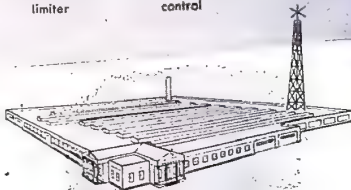


All controls logically grouped for easiest operation. Normal position for broadcast reception marked in red, making possible general use by whole family.

Automatic noise limiter

3-position tone control

Phone jack



## hallicrafters RADIO

THE HALLICTRAFTERS CO., MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 16, U. S. A.

Sole Hallicrafters Representatives in Canada: Rogers Majestic Limited, Toronto-Montreal



**DEPENDABILITY • STABILITY • ACCURACY**



**FIXED AND VARIABLE**  
**RESISTORS**  
*Preferred for Performance*



For Correct Use Consult the  
I. R. C. Resistor Chart.  
Send for your copy.

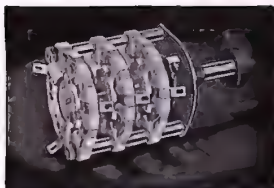
**INTERNATIONAL RESISTANCE CO.**

**401 N. BROAD STREET**

*Philadelphia*

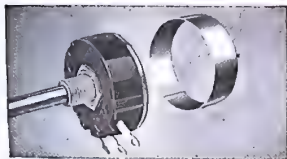
# Centralab

*The Quality Line*



## SELECTOR SWITCH

Available in an almost infinite variety of combinations . . . in bakelite or statelite . . . in single or multiple gang . . . from two to eleven positions on any one switch . . . also available for use in amateur transmitters.



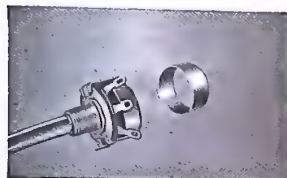
## STANDARD RADIOHM

Wall type resistor. Exclusive non-rubbing contact band.  $1\frac{3}{8}$ " diameter x  $9/16$ " deep. Available single, twin or triple, plain or tapped . . . with S.P.S.T., D.P.S.T. or S.P.D.T.



## MIDGET RADIOHM

Companion to "standard" . . . small size but large control efficiency. Available single, dual or triple . . . plain or one, two or three taps . . . with S.P.S.T., S.P.D.T., or D.P.S.T. Moulded bakelite case,  $1\frac{1}{8}$ " diameter,  $1/4$ " metal shaft  $3\frac{3}{8}$ " long.



## ELF RADIOHM

Smaller but also features the long, straight resistor strip. Available plain or tapped with S.P.S.T. switch . . . with or without dummy lug. Bakelite case  $57/64$ " diameter,  $17/32$ " deep (less switch)  $25/32$ " deep with switch.

Hams, Servicemen, Experimenters and Manufacturers appreciate the utter dependability of Centralab products. Since 1922 more than a hundred million radio parts bespeak the universal acceptance accorded Centralab products. Send for catalog if your jobber cannot supply you.

**CENTRALAB**  
Div. of Globe-Union Inc.  
MILWAUKEE



## LEVER ACTION SWITCH

Used singly or in groups . . . for broadcasting, receiving, public address, test instruments and industrial uses. Available in any one of ten different combinations including positive and spring return action.

## WIRE WOUND RADIOHMS

In values from 2 to 10,000 ohms . . . insulated construction . . . 3 watts . . . universal shaft for all replacements . . . regular Radiohm switch covers may be attached . . . in linear curve only . . .



## ATTACHABLE SWITCH COVERS

For standard and wirewound resistors (Radiohms) as well as Midget and Elf Radiohms . . . S.P.S.T. . . S.P.D.T. . . D.P.S.T. . . four point . . . S.P.D.T. (operates at clockwise position) and S.P.S.T. with Dummy Lug.



## AXIAL LEAD RESISTORS

Body is insulated by inert ceramic jacket . . . proof against vibration and humidity . . . will withstand five times rated load without permanent change. In two sizes . . . RMA coded . . .  $\frac{1}{2}$  watt at  $\frac{1}{4}$ " x  $\frac{5}{8}$ " and 1 watt at  $\frac{1}{4}$ " x 1" . . . Also supplied in conventional RADIAL LEAD Style . . .  $\frac{1}{2}$  watt - 1 watt or 2 watt.



## CERAMIC TRIMMER CONDENSER

where greater stability than ordinary types is required. Supplied with neg. temp. coefficient of .006 MMF/MMF/C°. With or without mounting brackets.

## CERAMIC CAPACITOR

Small "special purpose" for h.f. circuits where temperature compensation, low power factor, or absolute permanence are important. 1000 V.D.C. leakage resistance more than 10,000 meg. Power factor less than 1%.



**SEND FOR CATALOG NO. 23**

K-2  
Crystal

D-104  
Crystal

T-3  
Crystal

WR  
Crystal

PICKUP CARTRIDGE

FP. SERIES  
PICKUP

GDN SERIES  
Dynamic

*The Astatic*  
*Corporation*  
CONNEAUT, OHIO.

**ASTATIC**

Astatic Crystal Devices Manufactured  
under Brush Development Co. Patents



# RADIO and CODE OPERATORS

## GET CODE SENDING and RECEIVING Speed

### the WAY CHAMPIONS DO

You can now improve your present speed and proficiency in code sending and receiving with the famous Candler System, which trains you to meet all speed requirements of amateur and commercial licensed operators. You can learn code right from the beginning as you will be using it as an operator with the Candler System Training, and you will master it in half the usual time required.



WALTER H. CANDLER  
Originator of the famous Candler  
System and founder of the Candler  
Code Speed Training.

## SPEED UP WITHOUT TENSION OR NERVOUSNESS

You can take Candler Training wherever you may be. It qualifies you for higher rating and a better paying job. If you are seeking a license you will be able to qualify quickly. You will learn how to free yourself of all fear, tension or jitteriness and thereby apply your talents to speed and accuracy. Candler System Training has provided a background for some of the highest paid operators in the field. It is so surprisingly easy and inexpensive. It takes more than memorizing the code and merely sending and receiving to become a skilled radio operator. Ask any good operator. He will tell you CANDLER teaches you quickly, thoroughly, the technique of fast, accurate telegraphing, and trains you to meet all requirements. Why not let the internationally famous Candler System give you the speed, accuracy and technique to eliminate all worry and code problems.

### ★ COURSES FOR BEGINNERS and OPERATORS

**THE SCIENTIFIC CODE COURSE** is a complete radio-code course for beginners. It teaches all the necessary fundamentals scientifically.

**THE HIGH SPEED TELEGRAPHING COURSE** is for operators who want to increase their w.p.m. and improve their proficiency.

**THE TELEGRAPH TOUCH TYPING COURSE** is specially prepared for those who want to become expert in the use of the typewriter for copying code.

### NO EXPENSIVE PRACTICE EQUIPMENT NEEDED

Learning Code or Improving Speed and Accuracy are Mental Processes that require Special Training, which vast experience in developing high-speed operators enables CANDLER to give you simply, thoroughly, interestingly. Practice without understanding these laws and fundamentals governing speed and skill is always hard and wastes much valuable time. CANDLER shows you the EASY, BETTER WAY TO SPEED, SKILL and CODE PROFICIENCY, quickly.

## CANDLER SYSTEM

BOX 928 — DEPT. 7-A-6, DENVER 1, COLORADO

CANDLER SYSTEM COMPANY, 121 KINGSWAY, LONDON, W. C. 2, ENGLAND



World Champion T. R. McELROY

Official Champion Radio Operator. Speed 75.2 w.p.m., won at Asheville Code Tournament July 2, 1939, says: "My skill and speed are the result of the exclusive, scientific training Walter Candler gave me. Practice is necessary, but without proper training to develop Concentration, Coordination and a keen Perceptive Sense, practice is of little value. One likely will practice the wrong way."



SEND TODAY FOR THIS  
FREE Book of Facts

It gives you the story of CANDLER CODE CHAMPIONS, and many inside tips that will help you. It is FREE. A postcard will bring it to you. No obligation.



✓✓  
**ONLY HAMMARLUND RECEIVERS  
 HAVE THIS FEATURE...**

**UNITED STATES PATENT OFFICE** 2,222,043

2,222,043  
**SELECTIVE WAVE TRANSMISSION**  
 Donald K. Oram, Forest Hills, N. Y., assignor to  
 The Hammarlund Manufacturing Company, In-  
 corporated, New York, N. Y., a corporation of  
 New York

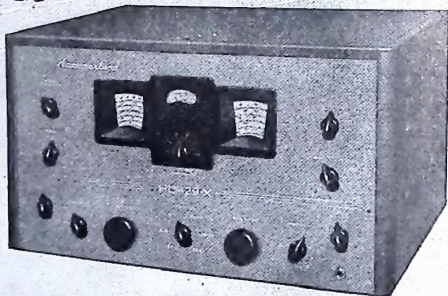
Application June 28, 1939, Serial No. 281,612  
 8 Claims. (Cl. 178-44)

This invention pertains to electrical apparatus  
 and circuits of the type known as filters and  
 more especially to such apparatus and circuits  
 of the type referred to as band pass filter.  
 One object of my invention is to provide a

Incorporated in such receiver to such a degree as  
 may be found necessary, and to make such re-  
 duction quickly and to a predetermined degree.  
 Another purpose is greatly to attenuate

**HQ-129-X**

The variable crystal filter  
 used in the "HQ-129-X"  
 and the "Super-Pro" is an  
 exclusive Hammarlund  
 patent. It provides wide  
 band crystal selectivity for  
 use in crowded amateur  
 phone bands and single  
 signal code reception.



**HAMMARLUND**

THE HAMMARLUND MFG. CO., INC., 460 W. 34TH ST., NEW YORK 1, N. Y.  
 MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT

# U. S. RADIO DISTRICTS

District	Territory	Address, Radio Inspector-in-Charge
No. 1	The States of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont.	Customhouse, Boston, Mass.
No. 2	The counties of Albany, Bronx, Columbia, Delaware, Dutchess, Greene, Kings, Nassau, New York, Orange, Putnam, Queens, Rensselaer, Richmond, Rockland, Schenectady, Suffolk, Sullivan, Ulster and Westchester of the State of New York; and the counties of Bergen, Essex, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Passaic, Somerset, Sussex, Union and Warren of the State of New Jersey.	748 Federal Bldg., 641 Washington St., New York, N. Y.
No. 3	The counties of Adams, Berks, Bucks, Carbon, Chester, Cumberland, Dauphin, Delaware, Lancaster, Lebanon, Lehigh, Monroe, Montgomery, Northampton, Perry, Philadelphia, Schuylkill and York of the State of Pennsylvania; and the counties of Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Ocean and Salem of the State of New Jersey; and the county of Newcastle of the State of Delaware.	1200 Customhouse, Second and Chestnut Sts., Philadelphia, Pa.
No. 4	The State of Maryland; the District of Columbia; the counties of Arlington, Clark, Fairfax, Fauquier, Frederick, Loudoun, Page, Prince William, Rappahannock, Shenandoah and Warren of the State of Virginia; and the counties of Kent and Sussex of the State of Delaware.	508 Old Town Bank Bldg., Baltimore, Md.
No. 5	The State of Virginia except that part lying in District 4, and the State of North Carolina except that part lying in District 6.	402 New Post Office Bldg., Norfolk, Va.
No. 6	The States of Georgia, South Carolina, and Tennessee; and the counties of Ashe, Avery, Buncombe, Burke, Caldwell, Cherokee, Clay, Cleveland, Graham, Haywood, Henderson, Jackson, McDowell, Macon, Madison, Mitchell, Polk, Rutherford, Swain, Transylvania, Watauga and Yancey of the State of North Carolina; and the State of Alabama except that part lying in District 8.	411 Federal Annex, Atlanta, Ga.
No. 7	The State of Florida, except that part lying in District 8.	312 Federal Bldg., Miami, Fla.
No. 8	The States of Arkansas, Louisiana and Mississippi; and the city of Texarkana in the State of Texas; the county of Escambia in the State of Florida; the counties of Mobile and Baldwin in the State of Alabama.	400 Audubon Bldg., New Orleans, La.
No. 9	The counties of Aransas, Brazoria, Brooks, Calhoun, Cameron, Chambers, Fort Bend, Galveston, Goliad, Harris, Hidalgo, Jackson, Jefferson, Jim Wells, Kenedy, Kleberg, Matagorda, Nueces, Refugio, San Patricio, Victoria, Wharton and Willacy of the State of Texas.	404 Federal Bldg., Galveston, Tex.
No. 10	The State of Texas except that part lying in District 9 and in the city of Texarkana; and the States of Oklahoma and New Mexico.	500 U. S. Terminal Annex Bldg., Dallas, Tex.
No. 11	The State of Arizona; the county of Clarke in the State of Nevada; and the counties of Imperial, Inyo, Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara and Ventura of the State of California.	539 U. S. Post Office & Courthouse Bldg., Los Angeles, Calif.
No. 12	The State of California except that part lying in District 11; the State of Nevada except the county of Clarke; Guam, Wake, Midway, Am. Samoa.	328 Customhouse, San Francisco, Calif.
No. 13	The State of Oregon; and the State of Idaho except that part lying in District 14; and the counties of Wahkiakum, Cowlitz, Clark, Skamania and Klickitat of the State of Washington.	805 Terminal Sales Bldg., 1220 S. W. Morrison St., Portland, Ore.
No. 14	The State of Montana; the State of Washington except that part lying in District 13; and the counties of Benewah, Bonner, Boundary, Clearwater, Idaho, Kootenai, Latah, Lewis, Nez Perce and Shoshone of the State of Idaho.	808 Federal Office Building, Seattle, Wash.
No. 15	The States of Colorado, Utah and Wyoming.	504 Customhouse, Denver, C.
No. 16	The States of North Dakota, South Dakota and Minnesota; the counties of Alger, Baraga, Chippewa, Delta, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Luce, Mackinac, Marquette, Menominee, Ontonagon and Schoolcraft of the State of Michigan; and the State of Wisconsin except that part lying in District 18.	208 U. S. Courthouse, St. Paul, Minn.
No. 17	The States of Nebraska, Kansas and Missouri; and the State of Iowa except that part lying in District 18.	809 U. S. Courthouse, St. Louis, Mo.
No. 18	The States of Indiana and Illinois; the counties of Allamakee, Buchanan, Cedar, Clayton, Clinton, Delaware, Des Moines, Dubuque, Fayette, Henry, Jackson, Johnson, Jones, Lee, Linn, Louisa, Muscatine, Scott, Washington and Winnebago of the State of Iowa; the counties of Columbia, Crawford, Dane, Dodge, Grant, Green, Iowa, Jefferson, Kenosha, Lafayette, Milwaukee, Ozaukee, Racine, Richland, Rock, Sauk, Walworth, Washington and Waukesha of the State of Wisconsin.	246 U. S. Courthouse, Chicago, Ill.
No. 19	The State of Michigan except that part lying in District 16; the States of Ohio, Kentucky and West Virginia.	1029 New Federal Bldg., Cincinnati, Mich.
No. 20	The State of New York except that part lying in District 2, and the State of Pennsylvania except that part lying in District 3.	328 Federal Building, Buffalo, N. Y.
No. 21	The Territory of Hawaii.	609 Stangenwald Bldg., Honolulu, T. H.
No. 22	Puerto Rico and the Virgin Ids.*	322 Federal Bldg., San Juan, P. R.
No. 23	The Territory of Alaska.*	7 Shattuck Bldg., Juneau.

\* Amateur applicants in Alaska and the Virgin Ids. are not required to take the Class B test but may apply for Class C.



## Other Publications BY THE AMERICAN RADIO RELAY LEAGUE

### QST

☐ The Official Magazine of the American Radio Relay League *QST* faithfully and adequately reports each month the rapid development which makes Amateur Radio so intriguing. Edited in the sole interests of the members of The American Radio Relay League, who are its owners, *QST* treats of equipment and practices and construction and design, and the romance which is part of Amateur Radio, in a direct and analytical style which has made *QST* famous all over the world. It is essential to the well-being of any radio amateur. *QST* goes to every member of The American Radio Relay League and membership costs \$2.50 per year in the United States and Possessions. All other countries \$3.00 per year.

### THE RADIO AMATEUR'S HANDBOOK

☐ "The all-purpose volume on radio." Text, data book, operating manual—it is all these and more. As a text it is probably more used in radio schools and colleges than any other single volume. As a practical constructional handbook, it stands in a class alone. As an operating manual, it provides information available from no comparable source.

#### STANDARD EDITION

The latest edition of The Radio Amateur's Handbook is postwar in content, containing 688 pages of the kind of material which has made The Handbook world famous. With the suddenness of peace it meant much redoing of the Handbook but this was done. Retained is the highly successful treatment of fundamentals which was an innovation of the 1942 edition. Stripped to essentials, the theory and design sections cover every subject encountered in practical radio communication, sectionalized by topics with abundant cross-referencing and fully indexed. An ideal reference work, this Edition also contains all the constructional information on tested and proved gear which has always been the outstanding feature of the HANDBOOK. \$1 postpaid in Continental U. S. A. \$1.50 postpaid elsewhere. Buckram Bound, \$2.50.

### THE RADIO AMATEUR'S LICENSE MANUAL

☐ To obtain an amateur operator's license you must pass a government examination. The License Manual tells how to do that — tells what you must do and how to do it. It makes a simple and comparatively easy task of what otherwise might seem difficult. In addition to a large amount of general information, it contains questions and answers such as are asked in the government examinations. If you know the answers to the questions in this book, you can pass the examination without trouble. Price 25¢

### THE A.R.R.L. ANTENNA BOOK

☐ A comprehensive manual of antenna design and construction, by the headquarters staff of the American Radio Relay League. Eighteen chapters, profusely illustrated. Both the theory and the practice of all types of antennas used by the amateur, from simple doublets to multi-element rotaries, including long wires, rhomboids, vees, phased systems, v.h.f. systems, etc. Feed systems and their adjustment. Construction of masts, lines and rotating mechanisms. The most comprehensive and reliable information ever published on the subject. Price 50¢

### THE HINTS AND KINKS

used in and the exclusive R patent. It provides band crystal use in crowd phone band signal code

☐ Amateurs are noted for their ingenuity in overcoming by clever means the minor and major obstacles they meet in their pursuit of their chosen hobby. An amateur must be resourceful and a good thinker. He must be able to make a small amount of money do a great deal for him. He must frequently be able to utilize the contents of the junk box rather than buy new equipment. Hints and Kinks is a compilation of hundreds of good ideas which amateurs have found helpful. It will return its cost many times in money savings — and will save hours of time. Price 50¢

### BECOME AN AMATEUR

### LIGHTNING CALCULATORS

☐ This publication is recognized as the standard elementary guide for the prospective radio amateur. Price 25¢

☐ Circular slide rules, on  $8\frac{1}{2} \times 11$ -in. bases, of special cardboard, with satisfactory accuracy. Two types: Type A solves problems in frequency, wavelength, inductance and capacity. Price \$1. Type B makes computations involving voltage, current and resistance. Price \$1.

THE AMERICAN RADIO RELAY LEAGUE, INC.

WEST HARTFORD, CONNECTICUT